COMMITTEE WORKSHOP

BEFORE THE

CALIFORNIA ENERGY RESOURCES CONSERVATION

AND DEVELOPMENT COMMISSION

In the Matter of: Preparation of the 2007 Integrated Energy Policy Report (2007 IEPR)	Docket No. 06-IEP-1N

VOLUME I

CALIFORNIA ENERGY COMMISSION

HEARING ROOM A

1516 NINTH STREET

SACRAMENTO, CALIFORNIA

MONDAY, JUNE 25, 2007

9:00 A.M.

Reported by:
John Cota
Contract No. 150-04-002

COMMISSIONERS PRESENT

Jackalyne Pfannenstiel, Presiding Member

James Boyd

Jeffrey Byron

John L. Geesman, Associate Member

Arthur H. Rosenfeld

ADVISORS PRESENT

STAFF and CONTRACTORS PRESENT

Barbara Byron

Steve C. McClary, MRW & Associates, Inc.

Robert B. Weisenmiller, PhD, MRW & Associates, Inc.

Lorraine White

ALSO PRESENT

Eric K. Knox, United States Department of Energy

J. Gary Lanthrum, United States Department of Energy

Allison Macfarlane, PhD, George Mason University and Massachusetts Institute of Technology

Robert R. Loux, State of Nevada

Alan S. Hanson, PhD, AREVA

Bob Halstead, State of Nevada

Timothy A. Frazier, United States Department of Energy

Richard L. Garwin, PhD, IBM Fellow Emeritus

Per F. Peterson, PhD, University of California

Frank von Hippel, PhD, Princeton University (via telephone)

Charles Ferguson, PhD, Council on Foreign Relations (via telephone)

Robert F. Williams, Advocates for Clean Responsible Energy

Neil W. Brown, Advocates for Clean Responsible Energy

Edwin D. Sayre, Advocates for Clean Responsible Energy

John Hutson, Fresno Nuclear Energy Group

Jane Turnbull, League of Women Voters

Carl Walter

I N D E X

I N D E X

P R O C E E D I N G S

9:07 a.m.

PRESIDING MEMBER PFANNENSTIEL: This is the Energy Commission Integrated Energy Policy Report Committee Workshop on Nuclear Power Issues. I am Commissioner Pfannenstiel. I am the Presiding Commissioner on the Integrated Energy Policy Report Committee. We have with us four-fifths of the Commission and in fact Commissioner Rosenfeld will join us this afternoon.

As introductions, on my left is Commissioner Jeff Byron, on my right is Commissioner John Geesman and to his right is Commissioner Jim Boyd.

We have a very full and very meaty agenda for the day. A lot of materials. I think that this is an opportunity, the first of two workshops on nuclear power, to really bring us up to date on what has been going on in this industry to make sure that as we discuss nuclear power in the Integrated Energy Policy Report we do so based on the latest information that's available nationally and internationally.

With that, we have an incredible amount of information and I think a wealth of talent in this room today and it will probably be so again on Thursday when we take this up again. With that, any Commissioners with opening comments?

None? I'll turn it to Lorraine. Thank you.

MS. WHITE: Good morning, welcome everyone. My name is Lorraine White. I am the program manager for the 2007 Integrated Energy Policy Report. And we welcome you to a workshop today that will feed into the development of the policies and recommendations put forth in this document by the Energy Commission.

Just a few logistical things to go over for those of you who are not familiar with the Energy Commission. We have restrooms just outside the double doors to the left. There is a refreshment snack bar upstairs, second floor, under the awning. We also have another set of restrooms behind the elevators.

In the event of an emergency we ask folks to please exit the building quietly following staff. We will meet up across the street at the park, Roosevelt Park, until we are given the all-clear sign to return.

As Commissioner Pfannenstiel has

mentioned we have a very meaty agenda today. We have an opportunity to fully discuss issues related to nuclear energy and we would very much participation in this discussion.

We have provided for public participation in several ways today. In addition to those of you who are here in attendance in person we also have provided a call-in number so that those on the phone or following along on our webcast can ask questions or make comments throughout the day. The number is 1-800-857-6618. A passcode is required. That passcode is IEPR. I am the call leader. And for those who choose to just follow along and listen to the audio it is being broadcast on our website.

All information related to this proceeding is also available on our website. Materials about this particular topic are available on the table out front as you enter the room. They are also going to be posted, if not already posted on our website under the notice for this workshop.

We encourage people who are here today or on the phone to ask questions of our panelists, make comments to our Committee, and fully participate to the extent possible in this discussion.

Nuclear issues are vast and require actually two days of discussion. The first day, today, we have two panels planned. Those panels will discuss issues related to spent fuel storage and disposal, and the federal reprocessing program.

Before those panel discussions take place we are going to be having a discussion on the status report for nuclear power in California. This is an update of the 2005 nuclear report that we did as part of our previous proceeding.

In the second day of workshops we are going to be exploring the operational issues associated with current plants and also delving into the environmental safety and economic implications of nuclear power to California.

In both days we are asking that public comments in terms of general comments be reserved until the afternoon. Questions about the particular topics being discussed in the panels will be allowed after the panelists have had a chance to speak.

For those of you who would like to ask

questions or make public comment, in order to ensure that everybody gets an opportunity we would like you to please fill out one of these blue cards. It helps us facilitate the discussions as we go through. They are available on the table out in front. And please specify if you want to make a comment or a question to a particular panel issue or if you want to actually make a general comment in the afternoon.

To put this topic in perspective. The California Energy Commission is required to develop an Integrated Energy Policy Report every two years. In the intervening years we are directed to update particular issues.

In this particular proceeding we have highlighted five specific areas outside of our normal assessment and forecast for energy resources. These topics include nuclear energy, which is the subject of today and Thursday's workshop, lighting efficiency, which was the subject of a workshop last week, land use and energy issues, that will be explored tomorrow, coal technologies and the cost of generation. These were the topics of previous workshops earlier this month.

From this information, from our assessments and our analysis, the input from parties, we develop and recommend policies to address the future needs of energy by Californians in the future. We address particular issues, make program recommendations and the like.

We are very dependant upon the information we get from various parties. Your participation is instrumental in allowing us to thoroughly explore these issues and develop the analysis on which these policy recommendations will be based. We also consult with our sister agencies at the federal, state and local levels.

As I said, this particular proceeding is a two-year cycle. In the odd years we develop the large, Integrated Energy Policy Report, in the even years we do our focused updates.

The current schedule has us adopting the overall Integrated Energy Policy Report by October 24th, in time to transmit it to the Governor and Legislature by the statutory deadline of November 1st.

As I mentioned earlier, all the information about this proceeding, this topic in particular, is available on the Energy

Commission's web site. You will also find the draft report that our consultants have put together updating nuclear issues and concerns for California, the Nuclear Power in California: Status Report 2007.

For general information about this proceeding I welcome you to contact me. The information to contact me is available on our website. And for topics or questions specific to nuclear power please contact Barbara Byron. She is our nuclear power lead at the Energy Commission. Her contact information is available in the notice for today's workshop.

As a bit of introduction I would also like to provide a brief bit of information on our two consultants who were instrumental in the development of the nuclear power in California status report.

Dr. Robert Weisenmiller is a principal and co-founder of MRW and Associates, Incorporated. Dr. Weisenmiller has both a PhD in chemistry and an MS in energy and resources from the University of California at Berkeley. Both of which he received in 1977. He also received a BS in chemistry from Providence College in 1970.

Dr. Weisenmiller has worked in the energy field for more than 30 years. From 1977 to 1982 Dr. Weisenmiller held several positions here at the Energy Commission. He was the advisor to a Commissioner, the office manager for the special projects office, and he was the director of the office of policy and program evaluation in the executive office of the Commission.

Since 1982 dr. Weisenmiller has been an energy consultant. In 1986 he was one of the founders of MRW and Associates. He has provided extensive analyses on energy markets and regulation, particularly in the west coast power and fuels markets for various end-users, financial institutions, gas pipeline and producer companies, qualified facilities, other developers, state governments and federal agencies.

In particular Dr. Weisenmiller has provided due diligence assistance for many of the major energy facilities in the west coast markets.

He has also provided expert witness testimony on numerous power and fuels issues over 100 times in both California and federal regulatory proceedings. And also in various civil litigation and arbitration proceedings. He's kind of a busy guy it sounds like.

He has provided numerous articles and professional presentations concerning California energy markets.

We also have with us today Steven McClary. He is a principal and co-founder of the consulting firm MRW and Associates as well, based in Oakland, California. Mr. McClary specializes in economic and regulatory policy analysis, electric and gas supply planning, contract support and transmission issues evaluation.

In the course of a career spanning over 25 years Mr. McClary has worked with public agencies, independent power producers, renewable energy providers, third-party retailers, municipal utilities, regulators, end-users, financial institutions, so on and so forth, on issues ranging from industry restructuring to transmission planning, stranded costs to exit fees, and contract disputes to asset valuation.

Mr. McClary is a veteran of the California Energy Commission as well and the Transmission Agency of Northern California. At the Energy Commission he was part of the team that conducted the 1977-78 initial investigation into nuclear issues mandated by the California nuclear legislation.

Currently he is working with us here at the Energy Commission on updating our review of nuclear issues, building on the work performed in 2005.

He is also helping other clients work through the aftermath of the California restructuring process and rebuilding California's state power markets. He us working with retailers, generators, to untangle and explain the newly restructured markets here in California. He has testified many times before regulatory commissions here at the California level and at the federal level, and before courts on matters related to energy markets.

With that I would like to introduce Barbara Byron who will be orchestrating the rest of the day. Actually we'll be handing it over to Steve.

MR. McCLARY: Thank you, Lorraine, for a very complete and very helpful overview on where this fits. Good morning. It's a privilege to be here again. As Lorraine mentioned I participated in the initial review by this Commission and in the last review by this Commission of nuclear energy issues.

As she said, I am Steve McClary, co-owner of MRW & Associates. Bob Weisenmiller, my partner, and I will be co-moderating, tag-teaming if you will, through today's and Thursday's workshop.

A little background here. And let's see if I can get us in business. Demonstrating technical skills right at the outset here.

As Lorraine said, MRW is preparing a status report update for 2007 on nuclear issues in California. This is a follow-on, it's both an update and a complement to a status report we prepared in 2005 on those issues for the last IEPR.

It's been a monumental effort in some ways. It's a broad range of issues to cover and trying to do it justice is difficult, as many in this room know. I would like to thank both the Commission and our staff for the support they have given us in being able to do that. In particular here at the Commission Barbara Byron has been stalwart in paving the way in helping us get this done. And on our staff I'd particularly like to acknowledge Heather Mehta and Laura Norin who put in yeoman hours and great effort in getting this put together for us.

What is on the website now and available for comment I'd like to emphasize is a draft report. It is a work in progress. The final version of that report will reflect what we learned here and from the public and from the utilities. Before it's finalized that report information from the utilities, input from the public and all commenters and the workshop that takes place today and Thursday will all go to inform the IEPR Committee in making its determinations on nuclear issues for the 2007 IEPR.

What I would like to briefly with Bob cover this morning is kind of a preparatory to our two-day workshop are several topics. Where the nuclear review fits into the IEPR process and the state policy. Where nuclear power stands today, what's the status in California. The status of storage, disposal and reprocessing issues and how that affects California and why we're looking at them.

I'll turn it over to Bob at that point

to lead us through a quick overview on issues related to the economics of nuclear power, the environmental and societal impacts in the future. Particularly here in California but it is inevitably tied up with national and international development of power. And then what some of the potential implications for California might be.

Background, as Lorraine has alluded to and as described more fully in the report. California nuclear policy is fundamentally established by legislation passed in 1976. Looking back to that time, this was in the years when the initial surge of nuclear power development was occurring in this country. Probably the most rapid development of a new power technology we've seen.

In California a concern over the development of the infrastructure, both waste disposal and reprocessing infrastructure, led to passage of legislation that essentially called a halt to new nuclear construction. It allowed plants currently under construction to finish but new nuclear plants were prohibited until, essentially, there had been federal approval of and demonstration of technology for fuel reprocessing and for high-level waste disposal.

During 1977 and '78 the Commission conducted an investigation into the status of those technologies, held extensive hearings, field interviews, and concluded early in 1978 that in fact it could not make the findings that those technologies had been approved or demonstrated and that in effect the moratorium remained in place.

That moratorium has since then remained in place. In 2005 the IEPR Committee here at the Commission revisited that as it became clear that there was an increase in interest and attention paid to nuclear power as an option. In the 2005 IEPR the Commission then reaffirmed those findings that were made in 1978, that the demonstration and approval had not in fact yet occurred. And that is where we are now today, is the next iteration of that.

It is important because nuclear power is a key element of the electricity resource system in California. Today nuclear power provides, depending on the year and the status of other resources, in the range of 13, 14, 15 percent of the state's electricity consumption. Thus it is on a part with such resources as renewables or hydro, which are also recognized as fundamental to the electricity system.

The importance of course, and this is something we'll hear more about over the two day workshop, is enhanced by the fact that it's regarded as part of, potentially a part of a way to address the expansion or continuation of electricity resources in an age where emission of greenhouse gases is a greater issue than it was certainly in 1978.

The nuclear plants in California are fundamental also in that they are something of a backbone to the electricity system in the state. They are, as is typical for nuclear plants, baseload plants. They run as much as they can. And performance has generally been consistent with national averages. With ups and downs as the case with any individual plant.

Here you see the capacity factors of the three principal nuclear plants that California relies on. Diablo Canyon is a PG&E plant, two units on the coast in Central California. That's the green line here and has show relatively high availability, particularly compared to the national average.

The SONGS, which is an acronym we'll hear over these two days, is the San Onofre Nuclear Generating Station. That's a plant owned primarily by Edison with minority ownership by San Diego Gas & Electric and the City of Riverside.

The SONGS plant has over the past few years shown, again, roughly equivalent to the national average, although there seems to have been some drop in capacity factor in the last year or so.

The third plant that California utilities rely on is the Palo Verde nuclear station in Arizona. And we will likely on Thursday hear more about that plant. There have been chronic problems with performance and that's reflected in the capacity factors you see here.

The issues that California faces related to storage, disposal, reprocessing, are the issues that the industry as a whole faces. And the legislation California obviously makes that, points the importance of those issues out very dramatically here.

On waste disposal, we looked at this extensively two years ago as part of the IEPR report and today, two years later, more in the nature of an update on how things are going with the Yucca Mountain Repository, which is the primary, maybe the only option that the federal government has seriously pursued on long-term disposal.

At this time we have yet to see the final license application submitted for review by the NRC. That is anticipated mid-year next year.

Final EPA standards have yet to be released on how to judge that application. Still some work to do there.

Legislation rationalizing or pushing forward action on Yucca Mountain expressing the frustration I think of congressional legislators on progress or lack of progress at Yucca Mountain. Didn't get anywhere in 2006.

And since 2005, two years ago, the projected opening, as stated by the Department of Energy, and again we will be hearing from the Department of Energy in the workshop, has slipped by five years. And that's a most likely kind of date. As we say here, it's possible it could open sooner than that but the anticipation is 2020 to 2021 before the Yucca Mountain Repository is in operation.

It's a discouraging picture and we'll hear more about it. I think summing it up, one of the more pointed references on this was by outgoing NRC Commissioner McGaffigan who as his swan song I guess from the commission, pointed out:

"As I prepare to depart the commission later this year, the opening of the repository is if anything, more distant than when I arrived in 1996. And it is absolutely dependant on the passage of legislation that currently has no chance of enactment."

One area specific to California -- specifically interested in California is the litigation. Many utilities across the country are pursuing recovery of their costs associated with the failure of the federal government to take their spent fuel on the originally anticipated schedule. That litigation is at various stages all across the country.

In California PG&E and SMUD have had a

quite successful pursuit I would say at this point and have been awarded roughly half of the damages they were claimed. There are appeals going on on both of those awards.

For Southern California Edison associated with San Onofre and APS associated with PV, Palo Verde, they're still in the process of establishing a trial date and getting that going.

Meanwhile the fuel continues to accumulate at the reactor sites. There has been continued effort to develop, build and use on-site dry cask storage. In the past the typical storage was in spent fuel pools, which were intended originally for very temporary, interim storage before shipment off-site. That role has been extended or decades literally. And as the fuel ages it becomes more feasible to store in a dry cask arrangement and that is happening.

At this point at San Onofre they are using that kind of storage and have been since 2003. Humboldt Bay, which is a retired reactor in the north part of the state is almost ready to start loading.

Diablo Canyon, they are building that kind of storage now. There are still some issues associated with the license for the storage that are being litigated and I think we'll hear more about that also over the course of the workshop.

Rancho Seco, another retired nuclear plant here in the Sacramento area has been shut down since the mid-80s and the fuel there has now been loaded into longer-term dry storage. All of this really necessitated by the fact that an off-site storage option has not been available for the fuel from these plants.

The third set of issues associated with the disposal or handling or how we will dispose of that spent fuel is the potential for reprocessing. In 1978 this Commission found that reprocessing was not a necessary element of the operation of a light water reactor-based nuclear industry. But that if it was necessary it had not been proven, demonstrated or approved.

In 2005 a similar conclusion was affirmed, although at that time there was not the renewed interest in reprocessing that there has been since.

What we'll be hearing about, particularly this afternoon, is a renewed interest in reprocessing technologies and a federal program announced early in 2006 that revolves around rebuilding and reprocessing capability and associated reactor technologies, largely aimed at addressing the concern over proliferation of nuclear weapons and fissile material. But also to some degree associated with reduction of waste, or at least a change in the nature of the waste that is generated by plants and how it can be disposed of. And there again I think we'll be hearing more about this over the two day workshop.

And at that point I'll turn this over to my colleague, Bob Weisenmiller.

DR. WEISENMILLER: Good morning. It's always good to be back at the Commission, and particularly to look at helping the Commission deal with these issues.

Obviously one of the key aspects of any resource is its cost. And for nuclear, most of its costs are associated with construction. The operating costs tend to be relatively low. And so an issue that certainly one looks at then is what is the expected construction cost. And this particular chart, as with many of the topics this morning, we're sort of giving you an overview. Certainly our report going into a lot of detail.

But we're going to hit this in more depth. Also with the various panelists.

So this looks at the history of nuclear power plant construction. All these have been brought into consistent year dollars. And all these are obviously more the first generation of construction. And now we present on that chart also some of the estimates for the second generation. In fact, some of our speakers are associated with these.

One of the higher ones is Jim Harding who will be here on Thursday. Since our report was published the Keystone Center came out with its report. Jim was a member of the Keystone Group but his numbers are relatively consistent with where the Keystone numbers came out.

Further down the chart we have the numbers associated with Constellation. And again we'll hear from Constellation on Thursday on how they have developed the numbers. And more characterized in the middle of those numbers is MIT or Paul Jaskow's numbers. Unfortunately, Paul couldn't be here on Thursday.

In terms of the obvious question of why are the numbers anticipated to be that different from before. In terms of things that would tend to drive the costs down there are subsidies, certainly in the Energy Policy Act.

There have been major changes in the licensing procedure. The Combined Operating Licensing Process, which should shorten and simplify that.

Certainly there's much more pressure for standardized reactor designs and much more pressure not to have each plant be a single, unique facility.

And the last point. Actually this was made by Peter Schwartz the last time when he was here that that first generation was built at a time of sort of unprecedented interest rates and inflation. Which is one of the -- Anyway, could not have been a worse time in terms of constructing capital-intensive projects like those.

In terms of some of the cost drivers on the up side. And again, Keystone certainly talks about there are potential choke points or places in the supply chain where there will be pressure as we go forward.

Certainly there has been a lot of talk

about uranium fuel prices going up.

Certainly on the materials side. I guess one way to look at the materials point is the Cal ISO presented testimony last week in the Sunrise proceeding. And they noted for transmission projects, or at least one particular one, the cost went up by 20 percent in one year. And that reflects the global pressure for steel, copper and all the pieces. So anyway, there's sort of phenomenal pressure on some of the components that could affect nuclear plants. Obviously they affect transmission lines. They can affect a lot of generation projects.

Labor costs. We talk about this some in the report. But the first generation of plants are operated by people certainly more my age than sort of coming just out of grad school. And those people are sort of looking at retirement.

So as we go forward into a new generation you're going to have obviously the California utilities competing on trying to retain or hire new people at the same time that the new plants will require additional labor. Certainly in terms of crafts for the construction process. Again there will be competition for those. All of which could affect pricing or should affect pricing in some fashion.

These are new technologies. They're simpler. But again, one can expect some degree of surprises for these.

And a lot of existing contractors who have overseas construction experience in the US. So anyway, the jury is out on what the costs are.

We looked some at the environmental and societal impacts. And again, these topics are going to be hit, certainly much more tomorrow, much more on Thursday. And indeed some of these were covered the last time. In some areas I think we're starting to help the state key up the issue.

Obviously nuclear power plants do not directly emit greenhouse gas emissions. They certainly don't directly emit significant amounts of air pollutants. At the same time just about anything that produces energy, in fact even a lot of Art's conservation measures require some degree of energy to construct them. That construction process or the disposal process at the end will have implications on it for greenhouse gas emissions.

Now looking at those -- And again, we'll have an interesting, I think an interesting presentation on Thursday that will look at how one does the lifecycle analysis. Look at some of the uncertainties there and try to figure out how to make some sense out of that. This is an area where certainly I think the state over time is going to have to investigate and look at it much more systematically for all energy technologies, not just for nuclear, but to get a better handle on that.

Once-through cooling. Obviously the last 2005 session dealt a lot with the cooling water impacts. And these -- also, I guess, the coastal impact there.

There are other impacts of nuclear plants and we're talking here of essentially routine operation, routine emissions. But certainly mining and milling has typically, has had some substantial adverse impacts in the southwest.

Uranium enrichment can in terms of its emissions. Certainly transportation, storage and reprocessing can.

And, you know, certainly one of the issues which has gotten some attention has been the tritium leaks. I'm not saying there's an abominable impact. It's certainly a relatively lower order than some of the other things we're talking about here.

But again, I think this sort of emphasized that these, particularly on the operation, tend to be relatively clean. But, you know, I think it's not anything one should be complacent about.

In terms of the future issues for California. Obviously the first issue that we're dealing with is the steam generator replacements. Those are under construction. Certainly I think the utilities will talk more about those on Thursday. But for the continued operation of these plants, the steam generator replacements have to occur in sort of a timely, cost-effective fashion.

Once those are done I think everyone anticipates the license renewal issues will be keyed up. Certainly the existing licenses expire more in 2022, 2025 period so we have a ways before these issues come up. And typically the review process at the NRC tends to be more of a couple of years. But everyone is --

PG&E has recently applied to the PUC for approval for some money to start studying this. The PUC granted that authorization but indicated that it wanted PG&E to come to a conclusion and come back to them for authorization to go forward. And to make sure that was done in a timely enough fashion so if the Commission were to conclude not to go forward that there would be time to look at options.

Last time Palo Verde was really, I would have to say a success story. I think generally when we talked to people going into the last status report Palo Verde was seen as a low-cost, highly reliable plant. It's not now. And again, we'll spend more time on this on Thursday. But it's had problems. It may or may not be associated with the steam generator replacement aspects there. It's gone through some debugging. And it has certainly been perceived more as one of the more problem plants in the nuclear fleet.

The interesting issue, there has been an awful lot of consolidation in the plant owners. And generally, there's certainly been studies done on the east coast, indicating that the plants that have been consolidated tended to be more the problem plants into the larger fleets that now have much better performance.

As we've looked at things generally we have also tried to pull together the knowledge base for the commission to move forward on stuff and also to start keying up the discussion of what are some of the implications.

And the first thing that is relatively clear is the on-site storage of the spent fuel will continue for awhile. I mean, even assuming Yucca comes on in 2021 there is a period of time to basically transport the fuel from the existing locations to Yucca. I'd estimate say 24 years or so. So that at least for decades the basic issue will be looking at on-site storage and what does that mean.

And associated with that, you know, I think the last time we indicated California has ratepayers who have paid over $1 billion to DOD for dealing with spent fuel and obviously the utilities are pursuing various breach of contract suits against DOE associated with that.

And to keep the plants operating, again, the interim fuel storage units have to come on-line. So with Diablo that is getting close but obviously still an open issue.

On reprocessing. And against this is one of the issues we'll talk about a lot. I think certainly the concern at this stage is that a lot of countries are talking about potentially nuclear power plants. And associated on the flip side of that capacity is it certainly enhances their capabilities more in the nuclear area. And with that the question is, what does that mean on the proliferation side.

And GNEP, obviously we'll talk about that a lot more today. It can either be seen as a way of trying to address some of those proliferation issues or it can be seen as really enhancing the problem. Certainly the program has been evolving. There are certainly technology choices that will affect exactly what GNEP is. And the consequences of GNEP in terms of the waste streams. Again, there will be a lot of debate this afternoon we can try to hopefully get a better, a more complete record out of.

But generally the consensus tends to be, and again our AREVA, I think, participant would tend to differ on this. Would be that it tends to raise the cost. And that generally moving forward with GNEP, even if successful, is going to take awhile.

I think in terms of once Yucca becomes operational, certainly the transportation issues will move much more to the fore. Once it's licensed, I guess. As we move from that to operational to transportation issues.

And certainly the California concern is always to make sure that there is not a disproportionate number of shipments through California. And associated with that, ultimately, California, because of the shipments will have its own associated costs and the state needs to make sure that it's at last recovering its costs form addressing this.

In terms of the workshops. This is just sort of recounting again the basic questions we're trying to hit today. And we can try to move forward on making the transition from our presentation over to the workshop itself.

We'd like to, again like Steve mentioned, emphasize that our report is a draft. We're certainly looking forward to comments on the report, particularly any factual issues to help us, you know, make it better. With that --

PRESIDING MEMBER PFANNENSTIEL: Before you go just a couple of questions on your perspective on two items. When you showed the levelized costs of the US plants and the projection you showed a bunch down at the very bottom kind of levelized cost, and then a very large clump up at the very top. What is your sense of what the difference is? Are there any easy to identify, specific drivers about those that came in relatively less expensively than those that came in relatively more expensively?

DR. WEISENMILLER: Some of the very, very early plants were more or less turnkey contracts, let's say on a promotional basis. So that led to, say from Edison's perspective, a very low cost for San Onofre 1. But it is not necessarily the case for the vendor in terms of cost, and the vendors only did that to basically kick start things.

At the high end tended to be things that were more caught up in the changes after TMI.

PRESIDING MEMBER PFANNENSTIEL: So is it fair then to say pre-TMI and post-TMI groups of plants?

DR. WEISENMILLER: That's part of it.

But even for the post-TMI part there was a very interesting RAND study that was done '76 or '77 and looked at the cost of plants, of nuclear plants. And again, that was certainly well before TMI. And found, again, a lot of cost uncertainty at that point. And they quoted one of the former chairs of the NRC as saying that, you know, just all the projections were hopeless at that stage. So like I said, that was at a pre-TMI period.

Certainly as we move forward I would recommend to people really digging into the cost stuff to look at the RAND study and try to make sure as we go forward and say, okay, have we really as we look at the licensing reforms, as we look at the standardization, are really addressing all the basic types of issues that plagued the industry at that time.

Because frankly we have a whole new set of issues we're going to face this time. We're going to be much more dependant on the exchange rate.

PRESIDING MEMBER PFANNENSTIEL: The other question as on your capacity factor slide. You showed that the national average is about 90 percent since 2000. Now a couple of decades ago

the national capacity factor was down under 70
percent, wasn't it?

DR. WEISENMILLER: Oh yes, yes.

PRESIDING MEMBER PFANNENSTIEL: It seems
like a big, big jump in the last two decades.

DR. WEISENMILLER: There has been a big
jump. And again, we will certainly get much more
into that on Thursday morning. There were
certainly problems with -- You know, I think as
the plants came on-line -- I don't know if you
want to characterize this as teething problems,
but there was a period of time that I think people
really had to work through with the plants to get
them operating much better.

And there was -- One of the big things
that occurred in that roughly 2000 period was
there was a lot of consolidation in the plant
fleet. And, you know, we went from, if you look
at say New England, where Northeast Utility had a
number of very troubled plants that were very
poorly performing. And ultimately they were
acquired and there has been much more
consolidation into the large operators. And the
large operators I think certainly have more -- as
opposed to places where you have or had a single

utility with a single plant.

And so with that consolidation there tended to be a very strong change in the sort of operation of those units. Like I said, there was analysis group studies of New York and New England that found one of the biggest benefits of restructuring was the transfer of those plants to more competent operators and enhanced performance.

Now the issue that we'll get into some on Thursday, so we've now gotten this big kick-up generally in performance, but these plants are also getting very old. And as we go forward for the next 20 or 40 years, you know, how much -- will they continue to operate that well or will there be problems? And we don't know the answer to that.

PRESIDING MEMBER PFANNENSTIEL: Well the quick follow-up to that then, are the higher performance associated perhaps with plants not being in rate base? Are they a question -- Well that is a question. Are there many that are not in rate base and if so do those tend to have a higher performance level?

DR. WEISENMILLER: Actually it's sort of -- One of the interesting questions which you may, you may want to -- Anyway, we look say at PG&E. As you know PG&E had a very incentive rate-making approach that had very high prices but very high performance.

And when you look at Northeast Utilities, which had very similar plants coming on-line at roughly the same time, they were -- they had to get much of their revenue from those plants in the market. So they kept cutting costs until they ultimately got to the point of the NRC shutting the plants down, requiring them to reapply.

And there is a MacAvoy book that compares the incentive structure that PG&E operated under to what Northeast Utilities operated under, under restructuring, and at that point tended to point more to the PG&E model. Now as you know, we are now back to cost of service in California, and certainly Palo Verde has always been cost of service. So it is --

Certainly the incentive question is a fascinating one that needs a lot more analysis or research.

PRESIDING MEMBER PFANNENSTIEL: Thanks.

ASSOCIATE MEMBER GEESMAN: I doubt that

we're going to resolve this in this year's IEPR cycle but I think we need to approach these statistics with a fair amount of care and a determination initially as to what perspective is it we are trying to bring to a jumble of numbers.

If in fact the perspective is that of investment in a new plant I think that ideally we could derive some guidance in this year's cycle as to how to cook out of the existing capacity numbers the survivorship bias that unavoidably impacts those.

It's a lot like the evaluation of investment performance. Poorly run mutual funds, poorly run investment portfolios tend to go out of business, they drop from the statistics. So looking at those that survive the period of analysis tends to have a bias upward.

On the other hand it is not clear to me at all that investment in a new plant looks anything like investment in the old plant. The proponents insist that this time it's different. Better technologies, better licensing process, lower interest rates.

And I think we're not going to resolve which is the correct perspective but we might try and make some progress in this cycle as to how to best frame the question.

DR. WEISENMILLER: That would be good.

With that let's start transferring over to the agenda. And like I said, we have a particularly full day today on this. The first panel -- I guess probably two housekeeping issues. One is that I see my role as sort of facilitating the conversation between the Commissioners and the panel. Certainly I'll help run the slides and give the bios. But basically this is the opportunity for the Committee to ask the questions that it wants to get to.

Now for the first panel we have just a couple of housekeeping issues. We have a number of panelists over the two days from the east coast and so we've been juggling around. And we have two panelists, Allison Macfarlane and Alan Hanson, who have to catch planes back to the east coast today.

So Alan we have brought in from the reprocessing panel this afternoon to this morning. And we need to make sure that they are out of here by 12:15-ish or so. So again, trying to keep them relatively earlier in the process than I -- I normally would put someone from the other panel at the very end but I don't want to jeopardize his flight so we have him sort of one back.

In addition someone else who should be on the panel, Kevin Crowley, will be calling in Thursday morning and he will cover the National Academy's transportation talk.

So anyway, there's a little bit of shuffling here to make sure that we could provide the best panelists for folks.

Okay, so our first panelist will be Eric Knox from the Department of Energy. And I think we're particularly happy to have someone here from the Department of Energy presenting the Department's perspective on Yucca Mountain. And I think certainly Eric is very, very well-qualified to do that. He has been involved in nuclear policy issues, particularly nuclear waste issues, since 1990.

At this point he currently serves as Associate Director for Systems Operation and External Outreach in the Office of Civilian Radioactive Waste Management at the Department of Energy.

And from May of 2002 through June of

2005 he served as the Senior Policy Advisor and Chief of Staff in the Office of the Undersecretary of Energy. And prior to that he was the Senior Policy Advisor in the Office of the Director of the Office of Civilian Radioactive Waste Management, Department of Energy. He also served in the White House during the administration of the current President.

Eric, you want to go for it?

MR. KNOX: Okay. Is this on? Okay. first of all I'd like to thank the Commission for allowing us to come in this morning and give you a quick status on the Yucca Mountain Project. And I'm going to go through my slides fairly quickly to allow more time for questions at the end. So with that if we'd go to the first slide.

As you know the mission of the Office of Civilian Radioactive Waste Management is to manage and dispose of the nation's radioactive waste and spent nuclear fuel. And currently there is material destined for Yucca Mountain at 121 sites in 39 states. That's the commercial nuclear power reactors, research reactors at universities, and legacy waste from the defense complex as well as Navy fuel.

The next slide, a quick picture of some of the waste that's going in there that will ultimately go to Yucca Mountain. And I think that picture is somewhat self-explanatory.

And the next slide simply shows where waste is today and how it is presently stored.

And then the next slide just kind of gives you a picture that you probably know more than I ever will about California's spent fuel locations. One thing I would mention here is that the nuclear waste fund, California has contributed almost $1 billion to the nuclear waste fund.

I want to give you a quick history of the nuclear waste policy because most people think that our country started trying to figure out how to dispose of spent nuclear fuel and high-level waste in 1982 with the passage of the Nuclear Waste Policy Act. But this actually goes back to the early '50s following the Manhattan Project and entering into the Cold War with the weapons programs and then early development of commercial reactors.

Different organizations in government, starting with the National Academy of Sciences, were commissioned to do a study going through different, you know, Atomic Energy Agency, the ERDA, different predecessor agencies to DOE were given tasks of looking at how do we solve this problem. So then you get to 1982.

So a lot of work had been done. Roughly 100 sites had been considered. Not studied as extensively as we did Yucca Mountain, but if you go back to the mid-70s, some of the early bore holes were drilled at Yucca Mountain. So there was a body of scientific data and evidence as they made some selections.

And I'll just kind of click through the next two slides. One is you go to the timeline, a history of nuclear waste policy. It shows where in the timeline the California moratorium was established.

But, you know, a couple of things I'll point out. The National Academy of Sciences in 1957 said deep geologic disposal was the way to go. They reaffirmed that in 1990 and then again in 2000 that determined that deep geologic disposal is the way to go to dispose of this stuff.

And also that is the general consensus of the international community. If you look at other countries like France, Finland, Sweden, and I won't name the whole list but including China and India, all are on the path to develop deep geologic repositories. None of which are operational yet. They are all destined to come on-line about in the same frame or after what the US is planning to do.

And then the next slide just basically shows the selection process. As I mentioned before, there were multiple site that were considered. They started out in 1983 with the creation of our office with nine, narrowed it down to five, three. And then Congress told us in 1987 just to study Yucca Mountain.

The next slide simply shows the location of where Yucca Mountain is in Nevada. The counties that are shaded in green -- I'm on slide ten. Okay, there you are.

DR. WEISENMILLER: We're on ten.

MR. KNOX: Okay. The counties in green show the counties that we provide oversight funding to as well as the State of Nevada. Inyo County, I'll mention in California, is one of the affected units of local government.

And the next slide is just basically to

show you where we are since 1982. And if you'll look the blue bubble shows that we will submit a license application by June 30 of 2008. And after that we go through the licensing process to get a construction authorization. And then we will go through -- Once we build the repository we'll go back to the Nuclear Regulatory Commission and seek a license to receive and possess. Our licensing process is a two-step process.

So we are -- Although it is over a long period of time we are in the final stages. And the check marks show the actions that are complete including the site recommendation, which was approved by Congress and signed by the President in 2002 determining Yucca Mountain is the site to develop a nuclear waste repository.

The next slide basically just talks about why this program matters. It's vital to national security, non-proliferation. Energy security, I'll mention that. The general consensus is that solving the waste problem is critical to moving forward with new-build nuclear power plants. And it also enables us to protect the environment.

You know, there are a handful of nuclear reactor sites that have been closed down and decommissioned. The sites are there. The only thing that's left is waste sitting on a pad. When you also look at the Department of Energy and the nuclear weapons sites, having Yucca Mountain operational is critical to being able to clean up and ultimately close those sites as well.

The next slide just shows all of the people that are interested in what we do and all of the groups and organizations that we interact with and have an interest in our program. And I won't try to go over every organization there but pretty much everybody at the federal, state and local level, tribal representatives and energy commissions are interested in what we do.

The program strategic objectives. Our new director, Ward Sproat, came in and set up four strategic objectives that he wanted to try to get accomplished during his time here and one is to get the license application in. I've mentioned that that will go in no later than June 30th.

On transportation. You know, I like to think of it as we don't want to be all dressed up with nowhere to go. Once we get Yucca Mountain built we do have to be able to transport radioactive waste to the facility. And so as we've experienced budget cuts over the past decade or so transportation has been one of the things to suffer.

And I want to mention too that Gary Lanthrum, who is the director of our transportation office, which we call the Office of Logistics Management, is here with me today so if there are, you know, questions on transportation he or I will be able to answer them.

Staffing. In 1983 when our office was set up we had an original mission as being a site characterization office. So when you look at the staffing that is required to do the intense geologic, hydrologic, seismic, volcanism, all the scientific studies that needed to be completed on Yucca Mountain, heavy on science and site-characterization disciplines.

As we are now in the final stages of developing our license application, planning to do construction, the skill mixes are different. The skill mixes you need to characterize a site are different than the skill mixes you need to prepare a license application, do the engineering, drawing and prepare the license application. And that's going to be different than what we need when we start constructing. And that will be a different skill mix than what we need as we move into operation.

So what we're doing now is working on the staffing, the staffing plans, the organizational charts to move the program forward as we move through phases.

And then the last thing is to address the government liability. As you know, in California as well as most of the rest of the country there are lawsuits pending against DOE because we didn't begin picking up nuclear waste in 1998 as we had contracted to do. And that current liability is estimated to be about $7 billion. And so working to address that liability is also one of our strategic objectives.

The next slide simply shows the schedule. And I will mention, you know, the 2008 date as the license application. We hope to begin the rail construction in 2009. And if everything goes according to plan the NRC will issue our construction authorization in 2011 and we should be able to operate in 2017.

And I will confirm, that is the best

achievable date. We don't think we can do it any sooner than that. If we get full funding then we should be able to do this in 2017 but not sooner. More money won't help us do it quicker.

Our budget request for 2008 is $494 million and that is to enable us to complete the license application and being the defense, license defense with the NRC as well as do some additional work in the program.

I just want to mention the program funding. The Nuclear Waste Fund was established to provide a mechanism to fund our program. It's paid for by the rate payers from across the country. And to date about $14.8 billion in fees have been paid into the Nuclear Waste Fund.

That fund is on account with the Department of the Treasury. It's a fund that by law we can invest in government securities. We are bringing in about $750 million a year from the rate payers and another $800 million to $1 billion a year in interest from that fund. It currently has about $19.5 billion in that fund available for Congress to appropriate to the Department of Energy.

We just issued our cash flow projections from 2009 to 2023 that basically talk about what it would take to build Yucca Mountain, have it operational, all the surface facilities constructed and complete, and that figure is $18.4 billion. So there's money there. The fund is going to continue to generate revenue from the ratepayers and interest from investments. So the funding mechanism I think is good. We just have to convince Congress to appropriate the money.

I've already mentioned the growing government liability. For every year of delay, I'll just jump to the bottom bullet, we estimate there's about a $500 million additional expense for each year of delay.

To address our ability to expedite the construction of Yucca Mountain the administration did last year, and did again this year, submit a legislative proposal to address permanent land withdrawal. I'll talk about that very briefly.

We identified 147,000 acres of land at Yucca Mountain which is part of Nevada Test Site, Bureau of Land Management and Department of the Air Force. This land is 100 percent owned by the federal government but it is titled to BLM, Department of Defense and Department of Energy for

Nevada Test Site.

Before the Nuclear Regulatory Commission will give us a construction authorization, before we can even begin construction, we have to have full and clear title of that land at Department of Energy for development as a repository. The only way that can happen is legislation. So Congress would have to provide us with the land withdrawal and retitle all of that property DOE for this purpose. And so we have to have legislation at some point.

And yes, I know we submitted it last year. I know we've submitted it this year. Immediate action on it doesn't look promising, although we are optimistic. But I also point out that when WIPP had to go through a similar program and get land withdrawal, and that took seven years. So we believe that we'll keep submitting it until we get it. And it is also possible that Congress could, or the Nuclear Regulatory Commission could issue us a construction authorization pending congressional action on land withdrawal.

Some other things that we addressed in there are licensing capacity limit. There is a

70,000 metric ton limit on Yucca Mountain. That is a statutory limit, it is not a technical limit. We believe that it just makes sense for the Nuclear Regulatory Commission to decide what the true, technical capacity is.

You know, there are some other things in there. I'll mention funding reform. That's actually to make it easier for Congress to appropriate money out of the Nuclear Waste Fund without getting into scoring issues, which are typical with budgeting processes. And those are the highlights. I'm happy to answer any questions on any other issues.

Reasons to move forward. It's time, number one. The liability is growing and every year of delay ensures a larger financial burden will be passed on to future generations. One thing I will point out here is the liability is not paid for out of the Nuclear Waste Fund, it is paid for out of the judgment fund, which resides at the Department of Justice. So that is a taxpayer cost rather than a rate payer cost.

And moving forward with your legislation does facilitate some of these obstacles and enables us to expedite construction and operation of the repository.

If I had to pick three key issues with the legislation I would say land withdrawal, the capacity limit and the funding reform.

Okay. I'll move over to the rail routes in Yucca Mountain. As you can see, the national rail corridors. If you would indulge me I'd like for Gary Lanthrum to come up and cover the next couple of slides on transportation. Is that okay?

PRESIDING MEMBER PFANNENSTIEL: Certainly.

MR. KNOX: Gary.

MR. LANTHRUM: Good morning.

PRESIDING MEMBER PFANNENSTIEL: Good morning.

MR. LANTHRUM: As Eric indicated I am Gary Lanthrum, I am the Director of the Office of Logistics Management, which is responsible for developing the transportation system to Yucca Mountain. Eric can speak about this as well as I can but we thought it would be appropriate for the person that is actually responsible for doing the work to talk about what we're actually involved in right now.

This map is out of the repository final

environmental impact statement that was published in 2002. It shows representative routes that were studied for rail to Yucca Mountain. The same environmental impact statement talked about highway routes.

There has been a lot of misinformation spread about the actual implementation of routing process and if we could go on to the next slide I'll talk about that a little bit.

For both rail routing and for highway routing there are typical rules in place. For rails, since the rail lines operate on privately-owned land, the railroads own the land that the track is on, they have standard industry routing practices.

And those standard industry routing practices are to use -- for shipments of spent nuclear fuel are to use the main line track to the maximum extent practicable, class one track, to minimize the number of interchanges as you go from railroad. To minimize the number of classification yards those shipments go through and to minimize the number of times that you change railroad operators. And to minimize the time and distance in transit.

There s a similar rule for highway shipments that's under the DOT regulations. It says basically that you'll use the national interstate system to the maximum extent practicable. That you can deviate that to get from a shipping site to the interstates. And you can deviate from that to get from the interstate to the receiving site. But again, you follow the interstates to the maximum extent practicable.

Looking at the map again the basic process if you follow those rules, both for highway routing and for rail routing, most of the shipments across the country would not travel through California to get to Yucca Mountain.

Now we are looking at ways of adjusting the shipment policies established by both the rail industry in terms of the rail practices and working with the states on highway shipments because states do have the opportunity to designate alternative highway routes.

We are engaged in a process of trying to identify what the criteria and methodology ought to be to adjust the standard process established by the rail industry and established by DOT to address local concerns. And Barbara is the state representative for California in the process. But it's a modification of the existing requirements and expectations for the shipments, it is not a wholesale tossing out of that process.

In addition for support of the shipments we are required under the Nuclear Waste Policy Act to provide funding for technical assistance and for training of emergency responders in the incremental effort to address the shipments that we would be responsible for. And again, that was to make sure that all the emergency responders along the routes that we would use, both the highway and rail routes, would be ready to deal with both normal operations and off-normal operations in the case of an accident.

So there is a fairly robust path forward for dealing with routing issues and routing questions that I think will comport with the basic shipment of hazardous materials in this country.

There is one thing that may impact our ability to work on a collaborative process for establishing routes. There were two notices of proposed rulemaking that came out back in late 2006 that the comment period closed in March of this year. One from the Department of Homeland

Security and one from the Department of Transportation. Both addressing rail routing of highly hazardous materials.

Highway route control quantities of radioactive material were one of the contents that was listed in both of those NPRMs. Both of the NPRMs looked at placing the burden for establishing routes on the industry rather than on a collaborative effort. The expectation was that the rail industry would do their own analysis of security issues and risks associated with various transportation options and based on that make the recommendations about the routing that would actually be used.

And so we're waiting to see, to some extent, what happens with that process. There is also legislation that was proposed that would do essentially the same thing. There is a lot of activity on looking at the security of all hazardous goods shipped around this country, not just spent nuclear fuel. We'll be paying very close attention to that.

I think the last slide, Eric, is back on to GNEP so I'll give that back to you.

MR. KNOX: The Global Nuclear Energy

Partnership. I know that a lot of people feel that this offers the hope that Yucca Mountain will not be needed. So all I'll say about this, because I know Tim Frazier from the Office of Nuclear Energy is presenting later and he will cover it in great detail.

Yucca Mountain is needed under any fuel cycle scenario. Even if all of the commercial spent fuel from the reactor fleet was able to be recycled, like most recycling process they are not 100 percent. There will be high-level waste product from that more than likely.

But even if it is more successful beyond our wildest dreams and it is 100 percent Yucca Mountain will hold the Naval reactor fuel and high-level defense waste, which is the byproduct of recycling or reprocessing. And that's ten percent of the waste material destined for Yucca Mountain but it's one-third of the volume. So Yucca Mountain will be needed under any fuel cycle scenario.

We are optimistic and hopeful that GNEP will enable us to reduce the volumes of waste that would ultimately be destined or repository but that is yet to be determined. So we believe that the best thing for us to do is to proceed with Yucca Mountain and base case.

And then in summary I'll just mention that you're going to hear from a lot of people today. Some won't be as optimistic as I am about the prospects for Yucca Mountain.

You know, that kind of reminds me, there used to be a reporter here in Sacramento named Mark Twain. And one day he picked up the newspaper and he read his own obituary. And I kind of feel like that with Yucca Mountain. His response was something to the effect of, tales of my demise are greatly exaggerated. And I think that is where we are on Yucca Mountain.

I have been with or following this program since 1990. I have never felt better about the future prospects for our success. And with that I'll be happy to answer any questions.

PRESIDING MEMBER PFANNENSTIEL: Jim.

COMMISSIONER BOYD: Thank you. First both Mr. Knox and Mr. Lanthrum, thank you for being here. It's a long way across the country to get here and it's good to put names and faces together. A couple of concerns.

First, Commissioner Geesman and I sat

through, who did the 2005 Integrated Energy Policy Report, we sat through lots on testimony on the subject of nuclear energy and all the ramifications, consequences when we did the 2005 Integrated Energy Policy Report.

And secondly, for the past five years and now into my sixth year, I am state's liaison to the Nuclear Regulatory Commission so I feel somewhat radioactive by now.

But nonetheless, having both of you here I just want to take the opportunity on this issue of question -- of transportation, excuse me, to just again reiterate the major concerns that California has on the subject.

And it's really two categories here. One, there's the current movement of materials and then there is the future movement of materials to the national repository. And I won't comment on Yucca Mountain one way or another, Mark Twain notwithstanding.

With regard to the current moment of materials, as I'm sure both of know, particularly probably Gary, California has rather magnanimously offered to use its, some of its highways to avoid routing material through my friend state of

Nevada, and Las Vegas in particular. But we have continually registered a concern with the quality of the highways that get used.

I have traveled that highway and I am not real happy with it. But I commend you for the fact that there's not been any accidents. And I'll just leave it lie that we continue our concern about the rerouting of materials through California over less-than the best quality highways to convenient other folks.

Secondly, on the rail issue I think we're on record as expressing our concerns with the possible routing of materials through California on our rails. We recognize we have a fair share role to play in the movement of materials. We have certainly used enough of it in this state and some of the backbone rail lines go through the state.

But California is a diverse, including mountainous state. And I, unfortunately was serving in California's brand new EPA, so to speak, when a railroad dumped a load of metam sodium into the Sacramento River and destroyed a lot of the fishery in that river and Shasta Lake and what have you several years ago. So it makes one nervous about moving materials over allegedly very safe rail routes.

So we will continue to work with you and express our concerns about the integrity of the rail routes that are selected. And also with regard to California, while playing and contributing its fair share to the movement of this, also being concerned that we do come up with ways and means of allocating the routes in a way they're equitable to all the states involved.

And of course you know we here in California are deeply involved with the Western Governors Association. I serve on their committee but in reality Barbara Byron does all the work so she and Mr. Lanthrum have had lots of opportunities to deal with that. So we have outstanding questions still remaining with your agencies about these issues and we'll continue to work with you.

But I just wanted to take this opportunity to just indicate to you they are a significant concern. I know you realize they are a significant concern and I just look forward to our continuing to try to resolve the question of safety and integrity.

We are getting quite concerned. I for one am getting quite concerned about the amount of material that is stored at our operating nuclear plants. As you indicated, it wasn't the original design, it wasn't intended to be that way. A lot of people are now feeling they would rather leave it there than ever move it.

That's going to be a contentious issue into the future involving the safe -- and assurances of the safe transportation of those materials. And I'm sure for many years into the future there's going to be lots of discussions about what constitutes safe movement and what constitutes safe highways and safe railways.

So again, just to express California's concerns. To personally, and again thank you for being here and taking your time. And Mr. Lanthrum, of taking your time to participate in this two full days of discussion that is going to be obviously quite interesting.

I appreciate the fact you have to get back and appreciate the fact that you took the time to be here. Thank you.

ASSOCIATE MEMBER GEESMAN: I too want to thank you for being here today. I have two areas of question. The first is a transportation one. And I want to quote an interview that Ward Sproat, who you indicated is the Director of the Yucca Mountain project for DOE, provided the Nuclear News published last January. And in the transportation area Mr. Sproat said:

"The transportation area has been the poor sister in the program for quite a while. It has always been the place where people trimming the budget say, we'll take the money out of transportation because it is so far into the future."

My question to you: Is there any indication, either at OMB or in the Congress, that that situation is turning around and that the transportation program will be put on a fiscally stronger footing?

MR. KNOX: Yes sir, I think it is. I hope it is. Just last week in the House an amendment was offered by a Nevada congressman to zero out our funding for 2008 fiscal year. That amendment failed with a vote of 351 to 80. So that shows strong, bipartisan support for funding our program.

And so, you know, I don't know that we'll have the same, you know, good fortune in the Senate but certainly on the House side we got a strong endorsement for our budget.

Future years, future congresses, yes sir there is risk, there is uncertainty. And the budget number has not been set for '08. That will certainly come much later in the calendar year.

But I think the evidence of the very strong, bipartisan support which this program has always enjoyed, in '92, 1987, and in 2002 on the site recommendation, and just last week I think is an indication that there is, there continues to be strong, bipartisan support.

That vote, the 351 to 80. I don't know that we have ever had as strong a vote in either house. But hopefully that is a sign that the funding will be there for transportation as well as the construction and development of Yucca Mountain.

ASSOCIATE MEMBER GEESMAN: My other question has to do with the EPA standard. And it was on one of your slides but you didn't speak to it. Could you go into that in some detail as to what you expect there and particularly the timing.

MR. KNOX: Yes sir. By law the Environmental Protection Agency sets the standard that the Nuclear Regulatory Commission will then enforce on our program that we will have to demonstrate compliance. That standard, you know, was supposed to have been done by now. Actually this is another version of the standard. The original standard was remanded in the courts because of the time frame.

The indications we get from the EPA are soon. There is a draft rule out now. So barring any major variances from that draft rule we're, you know, I think on track to do our license application based on the draft.

But that is an EPA standard, we don't control that. But in our communications with the EPA is they are telling us, soon. So soon in government terms I hope means, you know, weeks rather than months.

ASSOCIATE MEMBER GEESMAN: If that is held up would you go forward and submit an application based on the draft?

MR. KNOX: Yes sir, our belief is that

we can submit a license application based on the draft.

ASSOCIATE MEMBER GEESMAN: And assuming EPA does adopt a final standard. Is that standard subject to court review?

MR. KNOX: Certainly if someone litigates and my guess is that they would. Certainly it could be litigated.

ASSOCIATE MEMBER GEESMAN: Were it to be litigated would that affect the timing or the content of your application filing?

MR. KNOX: It depends on the outcome of the courts. You certainly can't speculate on a hypothetical or yet to be --

ASSOCIATE MEMBER GEESMAN: The mere filing of litigation would not impact your application?

MR. KNOX: I don't believe so.

ASSOCIATE MEMBER GEESMAN: Thanks very much.

COMMISSIONER BYRON: Mr. Knox, thank you as well from me for being here. We appreciate it very much. But I have to tell you, and this is not directed towards you, I have 25 years of pent-up anger around this issue.

I think that the elephant on the table, the dead elephant on the table is this confidence in our federal government's ability to do this job. If I understood you correctly I think you said it would be about another ten years at best.

MR. KNOX: Yes sir.

COMMISSIONER BYRON: And I can remember when we were waiting for the monitored retrieval of storage site in 1998 to start taking fuel, and of course that never happened.

I would just like to ask you if you'd speak a little bit more to this confidence issue. My fellow Commissioners have been through this a few times already, I think, so they're dealing with this in a very constructive way and I want to as well.

But the confidence issue in our government's ability to do this I think is extremely important. Not just for the potential for additional reactors being built in this country but we have four operating reactors that have spent fuel that need to be dealt with. So I'd like to ask you if you could address this ten-year issue in a little more detail.

MR. KNOX: Yes sir, I'd be happy to,

thank you for the question. You know, you're not the first person I have heard express frustration with our program. And oftentimes I feel it too because working in the government sometimes it just takes a lot longer to do simple things than we would like. But I don't think that's actually the reason.

A couple of things. You mentioned MRS. And that was the process where the government had a nuclear waste negotiator to go out and secure a voluntary site for an interim storage facility. That was not successful.

The key difference here is that in 2002 with a site recommendation. The siting decision has been made and there is a process by which we do licensing We could certainly be unsuccessful in our application for a license to construct Yucca Mountain but I don't think that will be the case. The licensing process allows for -- they don't just look at the license application and say, pass or fail. It's a long public process by which they can provide requests for additional information. We have an opportunity to respond and work through issues.

So the siting decision has been made.

And what that means is our job is, our missions is now to develop a repository at Yucca Mountain. We will work with our regulator to make sure that we respond to all of their questions and all of their inquiries. Any concerns they may have. And we get a license to build and construct Yucca Mountain and we will do that.

On the ten year issue. The licensing process by law is three years. The Nuclear Regulatory Commission can then return to Congress and ask for an additional year. So it's three to four years best case scenario.

So once get that construction authorization then we have to build it and that takes a while too. And we're also building this in the middle of the desert, 90 miles away from the nearest major city, which is Las Vegas. So it's a herculean effort to actually move men and materials to Yucca Mountain to actually construct it. So it's not, you know, an overnight construction process either so it's just going to take time.

But one thing I would point out. That the US, while we're a little bit ahead of the rest of the world I think the Russians in Obninsk actually had the first reactor available for producing electricity and putting it on the power grid, we were second. France, Germany, Switzerland, many of the other countries, Japan. None have a repository yet.

I think everyone is proceeding. While we may have some subtle differences everyone is proceeding with building a geologic repository. I would say no one is in a hurry because it is more important to do it right than to do it quickly. And we still should be the first country, given unforeseen delays.

And whether we're first or not I don't really think -- You know as a personal pride of an American I'd like to be first but at the same time it's more important to do it right. But even France is scheduled to come on line about 2020. Other countries are scheduled to come on-line mid-this century, the 2050 time frame.

So we're not out of the realm of reality for what other countries are pursuing and doing. So while the law required us to do it in 1998 and certainly we haven't performed on that I think we are on a path that is reasonable, that will provide for the safety that this country requires.

And get it done right. So between 2017, 2020, I think it is absolutely something that will become a reality.

COMMISSIONER BYRON: Well thank you. We're counting on you. Thanks for being here today.

MR. KNOX: Thank you.

PRESIDING MEMBER PFANNENSTIEL: Thank you, Mr. Knox, we really appreciate your involvement in this. Bob.

DR. WEISENMILLER: Our next speaker is going to be Allison Macfarlane. And again I'd like to really thank Allison for coming out. We tried last time and there was a conflict.

Allison is a professor of Environmental Science and Policy at George Mason University in Fairfax, Virginia. She is also affiliated with the Program in Science, Technology and Society at MIT. Also the Program in Science and International Affairs at Harvard. She has served on many National Academy of Science panels on nuclear energy and nuclear weapons issues.

I would note -- I mentioned the Keystone Study. Allison was one of the members of the Keystone panel so it's a chance for you to preview part of that.

And on Yucca I would point out that she has published a book, Uncertainty Underground: Yucca Mountain an the Nation's High-Level Nuclear Waste, which is very interesting. I should mention that she is a geologist by training.

DR. MACFARLANE: Good morning. Thank you very much for the opportunity to address you guys this morning. I do appreciate it. Sorry I couldn't make it last time but I'm glad I could make it now.

I am going to cover three, main different topics this morning that I'll try to rush through. That Barbara asked me to talk about. And I'll talk about repositories in general and Yucca Mountain in particular. Some of the technical issues associated with that, which is what my book covered.

I'll talk about capacity of Yucca Mountain, which is an issue that keeps coming up, especially with the GNEP program. And then I'll talk about waste with GNEP as well. So a little afternoon preview, I guess. So let me get right into it.

You have probably heard this before but

I just wanted to go over it briefly. In terms of how to get rid of high-level nuclear waste in particular. A number of options have been discussed. I would say that geologic disposal is by far the best option.

Others that have been discussed included shooting it out into outer space. Thinking of the Challenger disaster should give us all pause with that kind of option.

Putting it in deep sea sediments. There are issues with water circulation but most of the deep sea sediments that would be considered are in international water so I don't think that would get any traction.

And then finally, leave it where it is, interim storage, which is being promoted by a number of people now as the best solution. I don't see that as a long-term option. It's a short-term option, a 100 year kind of time frame. But longer term, as Eric pointed out, we really do need to do something with the stuff.

And also as Eric pointed out, geologic storage is going to be needed for any kind of fuel cycle, open or closed.

And I would say site selection is the

most important aspect of geologic disposal. And so let's talk a little bit about site selection.

When you site a geologic repository basically the idea is to use the multi-barrier system. So you use natural barriers, which are the rocks themselves, which hopefully will provide long travel times for any radionuclides that escape from a repository, dilution of radionuclides in groundwater, and sorption of radionuclides into the rocks themselves.

In concert with engineered barriers, which would be the waste form itself in the canister material and any other materials that are put in the repository. So the idea is to use both of those in concert to provide as much protection as possible.

One sort of proviso is that you can't make any kind of repository 100 percent air-tight and solid forever, okay. There will always be some leakage at some point in time in the future. And some point in time in the future may be millions and millions of years from now. But that's something that everybody should realize.

The International Atomic Energy came up with four, general siting criteria in 2003. And I think these siting criteria are quite good and so I'd like to keep them in mind and discuss them a little bit in terms of Yucca Mountain.

One is your site should have long-term tectonic stability. That basically means you shouldn't have earthquakes and it shouldn't be volcanically active.

Second, you should have low groundwater content, especially low groundwater flow. So if you're putting your repository below the water table, which most countries are doing, the groundwater doesn't move.

Third, that you have stable geochemistry at depth, at depth, including -- and this I think is very important -- a reducing environment. Sorry to put a lot of chemistry on you. What I mean by a reducing environment is there is no free oxygen present. So basically that for the most part often means under the water table.

And of course you want an excavatable site.

In addition you'd like a site that's deep enough so you don't have to worry about erosion. That is far enough from populations but accessible to transport. Those two criteria often are in contradiction, of course.

And then you don't want a potential for human intrusion so you don't want, you know, gold deposits or oil or something right where you're going to put a repository because you don't want people to dig into it later.

So let's talk about how this applies to Yucca Mountain. Is Yucca Mountain a reasonable site. I would say it sort of depends on the time frame. If you're only looking at 1,000 years then it's probably the reasonable site.

But if you're looking more than 10,000 years, and that's what the standard is now. The draft standard actually, the EPA standard goes out to a million years, I would say that it is much harder to make a strong argument for Yucca Mountain as a reasonable site because it violates two of the four International Atomic Energy Agency siting criteria. One is that it is tectonically active. And the second is that it is an oxidizing geochemical environment. And I'll talk about those two aspects in a little bit more detail in just a second.

But I just want to point out that because of these two violations it requires, basically Yucca Mountain requires more engineering fixes and therefore there's greater uncertainty in terms of how the repository is going to perform over time as compared with sites in other countries. And the other countries I'm thinking of in particular here are Sweden and Finland. And I can talk more about that later if you want me to.

So let's talk about tectonic stability. So this is a map of earthquakes in the California/ Nevada region. All those circles are color-coded according to time. And this goes from earthquakes from 1812 to 1994. So the more recent ones are in red. And the size of the dot corresponds to the magnitude of the earthquake.

Yucca Mountain, and I guess there is no pointer so I am going to use a pen. This square here, that white square is where Yucca Mountain is, okay. And so you can see there is a fair bit of activity around Yucca Mountain. Now that activity to the northeast is mostly nuclear weapons tests, okay.

But what I would call your attention to is the activity to the southeast. In 1992 there was a magnitude 5.6 earthquake on an unexposed fault at Little Skull Mountain, which is about 20 miles southeast of Yucca Mountain. And there were over 2,000 after-shocks on Jackass Flats, which is the basin adjacent to Yucca Mountain just to the east. So it is a tectonically active area.

Moreover, here is a fault map of Yucca Mountain. This line here is the exploratory studies facility that has already been mined out. And the dotted line is where the waste would go. And notice that it's an area that's carefully selected to make sure that the fewest number of faults are included in it.

Now the faults are all those other vertical lines in there, the dotted lines, and the solid gray lines, okay. So all those lines besides the exploratory studies facility and the dotted line that shows -- the dotted black line, the outline of where the waste would go, are all faults. And most of the north/south ones are considered active. So you are limited there by the geology. Okay.

It is not only seismically active but it's a volcanically active area. I took this photo standing at the crest of Yucca Mountain looking to the valley just to the west and those two cones are volcanic cones. They are a million years old.

This is a map of the volcanic rocks in the area. Here is Yucca Mountain. These are the cones that I took a picture of. That red dot at the southern end of Yucca Mountain is the thing that's really concerning. That's the Lathrop Wells Cone, it's 80,000 years old. And that means, in terms of geology, it's still active. The problem is we don't have a lot of those young, volcanics around so we can't say how active really, and that's the problem. There's a question about that.

So there are five quaternary basaltic volcanoes within 20 kilometers of Yucca Mountain. As I said, Lathrop Wells is the youngest.

The problem is two-fold. Could there be an explosive center under Yucca Mountain? Well, you know, that's probably not so likely. But if it were true it would be rather problematic because you wouldn't want to put all this material into the atmosphere.

The more concerning scenario from my point of view is that you get magma that intersects the tunnels at Yucca Mountain. Magma itself is very hot and corrosive. It's usually associated with very hot and corrosive gases and liquids and that would basically lead to a rapid disintegration of the canisters and you'd end up with radionuclides in the water a lot sooner than you had planned on.

Currently the Department of Energy and the Nuclear Regulatory Commission are in order of magnitude off in their estimates of probabilities of volcanic events so I'd say there's a lot of uncertainties associated with whether there will be volcanism in the future at Yucca Mountain.

Okay, the other issue I said I would talk about is this issue of the reducing or oxidizing environment. And this comes into play because of the spent fuel itself. Spent fuel, as you probably are aware, is basically uranium dioxide. Okay, the nuclear, the pellets themselves. And it's uranium dioxide, that's the problem. Uranium dioxide is not stable under oxidizing conditions and in the presence of water.

And yes, there will be humid conditions within the repository once it's closed. So you will have an oxidizing environment and you will potentially have a supply of water.

What happens is it forms complexes with different materials, ionic materials that are available, and it forms phases that tend to be highly soluble. We don't know a lot about how these alteration products behave, okay. But these reactions can occur pretty quickly. So basically we have a lot of uncertainty as to how this situation would unfold over a very long time scale. Again, the United States is the only country using an oxidizing environment for high-level waste storage and I would say this introduces large uncertainties.

Okay, on to the question of capacity of Yucca Mountain. As Eric pointed out the statutory limit at Yucca Mountain is 70,000 metric tons, 63,000 of which is going to be spent fuel from nuclear reactors.

In its environmental impact statement the Department of Energy suggested that the capacity of Yucca Mountain could be as high as 119,000 metric tons. If you look at the amount of spent fuel and defense waste if all existing reactors are given 20 year license extensions you'd end up with about 140,000 metric tons of fuel, of material that needs to be disposed of.

That's not counting any nuclear expansion whatsoever.

The Department of Energy is required by the Nuclear Waste Policy Act to determine the need for a second repository sometime between 2007 and 2010. And this has basically been one of the main drivers for the Advanced Fuel Cycle Initiative, the GNEP programs.

And estimates that have been published by either DOE labs in support of GNEP and by EPRI basically don't consider any kind of geologic limitations on capacity, they are only based on physics calculations of thermal capacities.

So the question is, how much could Yucca Mountain hold if there is an expansion. And there are a number of constraints on that. I can't give you an estimate yet, I haven't done all the calculations myself and the investigations as well because a lot of it includes detailed, geologic investigations. Of course the waste itself is a constraint on the capacity.

But the geology of the site is really important, especially because this site contains so many faults and fractures. You want to avoid them so that will limit the capacity of the repository.

Potential volcanism areas will limit the capacity of the repository.

The water table. Increases in elevation to the northwest, and that will limit the capacity of the repository spreading out in that direction.

And of course, the rocks into which you are placing your repository don't go on forever in all directions, they tend to thin out, and so that will limit the repository capacity.

You also want to avoid features in the rocks called lithophysae, which are crystal-filled cavities. So that, the full extent of the repository really isn't known yet.

Okay, so now turning to the Global Nuclear Energy Partnership waste stream. GNEP is partly portrayed as a way to reduce the volume of high-level waste. But I would argue that it is actually a waste proliferation program, and let me explain why.

The reprocessing technique that is planned on being used, at least right now, is something called UREX+1a. And it would generate a number of different waste streams including a number of gases like krypton, iodine and tritium.

Uranium. Technetium. Cesium and strontium. The transuranics, which would include the plutonium, neptunium, americium and curium. Fission products, cladding hulls and other streams. And let me talk about where these things would go.

The gases. Well first of all the Department of Energy has not perfected their removal yet. But once they do they would need to have some kind of storage plan for them. So that's something that would need to be stored and cited somewhere.

Right now countries that would process waste like France and the UK release these materials directly to the environment. And this causes other countries, like for instance Ireland, to be rather upset that the UK is putting this stuff into the Irish Sea.

Uranium. Department of Energy wants this to be low-level waste. You would need a site for this of course. That needs to go somewhere. That needs to be cited. And it must be very pure for this to be considered low-level waste and the Department of Energy believes that it has achieved those purities so far.

Technicium has been sort of singled out

as a separate material and the idea is it would go to a high-level waste repository once the Department of Energy figures out a good waste form for it. The only reason that technicium is being sort of separated out separately is because of the oxidizing environment at Yucca Mountain. Were Yucca Mountain a reducing environment technicium wouldn't be an issue.

Cesium and strontium. The idea with cesium and strontium. These are basically the main heat source in high-level nuclear waste. Now if you can take that main heat source out you can create a lot more space. So the idea is to take out all the cesium and strontium.

These guys have, cesium 137 and strontium 90 have half-lives of about 30 years. That means after ten half-lives have passed, 300 years or so, the material, Department of Energy plans, can be considered low level waste.

Well, there are a lot of questions associated with this. When they separate it out where is it going to go? Who is going to ensure the safety of it for 300 years? And then where is it going to go as low-level waste?

And then there's this additional problem that there is also an isotope called cesium 135 which has a half-life of 2.3 million years that will be almost impossible to separate from the cesium 137. And the presence of that cesium 135 will probably not allow it to be considered low-level waste. So in fact what are you going to do with this material?

The transuranics. Okay, the plutonium, neptunium, americium and curium. The idea is to put all of those materials into fast reactors. There will be wastes associated with these from fabricating and processing the fast reactor fuel. Where will these wastes go?

The fission products and cladding hulls. This is the stuff that is obviously going to go to a repository, high-level waste repository.

And there will be other waste streams including raffinates, other materials that are used in processing. And of course there is the decommissioning of the reprocessing facilities themselves that haven't been considered. So there are quite a few waste streams here that need to be dealt with.

In conclusion I'd say the best solution still for high-level nuclear waste, including spent fuel, are geologic repositories. I haven't changed my mind on that one.

Yucca Mountain I would say is probably not suitable for the long-term.

And Yucca Mountain's capacity is not determined yet and will be limited by the geology.

The GNEP program creates more waste problems than it solves and so I would argue that right now we need a plan B for high-level waste in the United States and GNEP is not it.

So I'll take your questions.

PRESIDING MEMBER PFANNENSTIEL: Thank you for being here and for that excellent presentation. Do you have a sense that other countries are ahead of us, have made some progress in areas where we have not yet?

DR. MACFARLANE: My bet would be that Finland are Sweden open their repositories before we do. Especially Finland.

PRESIDING MEMBER PFANNENSTIEL: And how are they solving some of what we're facing?

DR. MACFARLANE: Well they're using, they're using a geologic repository. They've got an easier time on the transportation because their reactors and their waste sites are located on the coastlines so everything gets transported by boat.

They have selected sites that -- Sweden is still looking at two sites and trying to down-select between those two. Finland has selected one site that it is looking at in more detail. These sites are in reducing environments. They're under the water table. They're in crystalline rock, granite or gneiss metamorphic rock.

They are going to -- Because it is this reducing environment they really reduce the uncertainties associated with what happens to the spent fuel over time. They are going to use a canister material, copper, elemental copper. And the copper itself we know from, you know, hundreds of million year old elemental copper deposits, that given the right environment, a reducing environment, the material will just sit there. So again their canister material reduces uncertainties as well.

In terms of the public, the public has a lot more confidence both in Sweden and in Finland I think, of the organizations, the entities doing the waste disposal. And in both countries the entities doing the waste disposal are from the nuclear industry, they are not from the government.

PRESIDING MEMBER PFANNENSTIEL: Thank you. Other questions?

COMMISSIONER BYRON: Dr. Macfarlane, thank you for being here. Given the four criteria with regard to siting, and if I understood you correctly we kind of with Yucca Mountain don't, in your estimation don't really meet two of those criteria. Are there any domestic sites that would meet all four criteria?

DR. MACFARLANE: Sure, there's tons of them, this is a big country.

COMMISSIONER BYRON: Okay.

DR. MACFARLANE: It's got a lot of different geology.

COMMISSIONER BYRON: All right, thank you.

DR. MACFARLANE: But by the way, the 1987 Nuclear Waste Policy Amendments Act precludes looking at any crystalline rock. Purely for political reasons. To keep it off the east coast. Just FYI.

COMMISSIONER BYRON: I didn't know that, thank you.

ASSOCIATE MEMBER GEESMAN: I didn't

understand the significance of the groundwater elevation in the northwest quadrant of the site and I wonder if you could go over that again.

DR. MACFARLANE: Sure. The way that the Yucca Mountain repository is designed is that it is designed to be above the water table.. And so you wouldn't want to extend it too far where it might intersect the water table.

Now you might say, well you've been arguing that other countries have been putting their waste below the water table so why is this a problem. Well actually when Yucca Mountain was originally considered as a site it was considered as a site for below the water table. And the reason that it was rejected was that the water moves too fast under the water table because the rock is so fractured and so it violated that slow-moving groundwater aspect.

ASSOCIATE MEMBER GEESMAN: Thank you.

COMMISSIONER BOYD: If I might. The sites that were under consideration before the decision, political or otherwise, was made to put the repository in Yucca Mountain. Did any of them meet your four criteria?

DR. MACFARLANE: You mean of those three

or the nine?

COMMISSIONER BOYD: Either. You choose.

DR. MACFARLANE: In 1986 there were three sites that were being considered, one was the Hanford, Washington site, one was Yucca Mountain, the Nevada Test Site, and one was Deaf Smith County, Texas, a bed of salt.

Hanford definitely violated everything, it was a stupid site. It was owned by the federal government. That was probably the only reason. And it was probably partly already contaminated. But otherwise it's dumb. The basalts there are highly fractured.

Salt is interesting. Some of the salt sites might be reasonable except that if you choose to go with salt for high-level waste you would have to cool the waste. You can't put thermally hot waste into salt because you don't want to mobilize any of the brines, the fluids that are in the salt. You don't want to mobilize them and dissolve the salt and dissolve the waste. Because salt itself is very, very corrosive, of course, salt water. But salt, from a geologist's point of view salt is interesting because it is so simple. No fractures, that kind of thing.

But I think there are plenty of other sites within the country that would be reasonable. Early, early on in the process there were a number of crystalline rock sites considered in the east coast and I think we could open that up again. I shouldn't probably say that. Everybody is going to be up in arms now.

COMMISSIONER BOYD: You're out here on the west coast, it's moderately safe (laughter).

DR. MACFARLANE: Don't worry, you guys have crystalline rock too.

COMMISSIONER BOYD: They don't pay much attention to us out here. Thank you.

PRESIDING MEMBER PFANNENSTIEL: Thanks very much.

DR. WEISENMILLER: Our next speaker is Bob Loux from Nevada. He has been the Executive Director of Nevada Agency for Nuclear Projects, the Nevada Waste project Office, since 1983. So we're having some contest on who has the most history here on Yucca Mountain. And as you recall he was here the last time and talked about these issues. So Bob.

MR. LOUX: Thank you. Good morning, I want to thank you all for having me back.

COMMISSIONER BOYD: Is your mic on? Please grab a mic.

MR. LOUX: I would like to thank you all for having us back again from 2002. It was very educational at that point in time and has been already this morning.

One of the things I wanted to sort of try to address early on was sort of one of your questions in the brochures sort of in the terms of the update. So what has changed? What has changed, what hasn't changed? In a sense nothing has changed but really in another sense everything has changed, as I'll explain in a moment.

Nothing has changed in that we still sort of have an artificial schedule for a repository opening date that in estimation likely can't be met.

There is still, as you heard earlier, no EPA standard. There is still no final NRC licensing rule that is dependant on the EPA standard.

There are still no final designs for any of the facilities that DOE is proposing and there aren't plans to be any in the repository application.

There are no final designs for the transportation, storage and disposal canisters. There may likely not be any by the time the repository or license application is submitted.

It is still, contrary to popular opinion, losing support both on the Hill and the industry. The slide of Commissioner McGaffigan's remarks, but others have made similar remarks. As you might recall in 2005 I put forward a litany of these sorts of remarks of people talking about the project. And that really hasn't changed.

And DOE is still having their budget cut by the Congress in every year that's occurred since then.

In another sense everything has changed. Senator Reid from Nevada is now the majority leader of the United States Senate. And to the degree, and as Ward Sproat said earlier this year and in the past year, two things had to happen for him to be able to submit a license application. One is that they needed the legislation or most of the legislation that is being proposed. And they needed full funding of $494.5 million for FY 08.

Senator Reid and I think Nevada's delegation as well as others have changed this landscape dramatically. I note that every Democratic candidate running for office, for president, has vowed to kill Yucca Mountain upon election if that's the case.

So to the extent that DOE and the project need this legislative help the prospects, as Eric indicated, I think are quite dim. There will be no fixed Yucca bill this year. There will no land withdrawal. There will no water rights. There will be no op budget or reform of the funding mechanism.

There will be no exemption from RCRA. A requirement DOE has is that the repository itself is going to generate nearly 500 million pounds of heavy metals that are otherwise land banned exempt. Banned under EPA standards.

There will be no pre-emption of all the transportation laws in the country that DOE proposed.

There will be no removal of the capacity that we talked about earlier.

There will certainly be no shortened or abbreviated NRC licensing process as part of the bill. There will be in interim storage. There will be no prescription of the Air Force's role in

Nevada over Yucca Mountain. They own the air space over Nellis.

All of these things DOE said in the past that they need and likely are not going to happen by June '08.

The international rules and aspects of the project that Allison and others have touched on are interesting as well. We talked about the reducing environment, we talked about the below water table.

But one of the key elements is that every other repository program, and in fact every reactor program, is based on the concept of multiple barriers and defense in depth.

And as I'll show you with my first slide -- This is a cutaway of the engineered barrier system at Yucca Mountain. You can see the tunnel, the inserts. And I want to call particular attention to in the back the blue, little titanium drip shields or tents that are designed to go over the waste canisters to protect them from water dripping on them.

Can we go to the next one. One more.

This is from the Department of Energy's performance assessment. And you can see that DOE has projected that about 99.7 percent of the entire repository performance is dependant on the engineered barrier system. The balance of anything to do with Yucca Mountain. On the right hand side the overburden, the geology, you can see contributes virtually nothing to waste isolation.

So unlike other countries' repository programs, unlike our own reactor program, there is no defense in depth. There is no multiple barriers. There is one barrier only. The entire performance of Yucca Mountain depends solely on the metal containers that the waste is put in. Next slide.

Now this is sort of hard to look at and I won't try to interpret it too much. But the doses, if you illuminate the waste package and the drip shields, you can see that the doses reach peak around 2500 years and very quickly continue at a very large measure.

The problem here with the site and the point I am trying to get to is that since we're dependant entirely on the canisters for disposal then the corrosion and the environment in the tunnel in Yucca Mountain becomes critical.

And as you heard earlier, we have an

oxidating environment in the tunnel at Yucca Mountain. DOE intends to have the internal temperature of Yucca Mountain very, very high, near the boiling point of water.

And because the rocks itself are about 90 percent saturated in the tunnel with water already we don't need any more infiltration. Because they're saturated to about 90 percent already we have 100 percent humidity, high heat, oxidizing environment. And the mineral content in this water that is perched in the rocks already contains heavy concentrations of mercury, fluoride, lead and arsenic.

The reason those are important is that for the drip shields, which are proposed to be made out of titanium, fluoride is a big killer for titanium. In fact both the state and the Nuclear Regulatory Commission's research arm have data that demonstrates the titanium shields' lifetime in the tunnel is probably no more than 50 or 60 years maximum due to the corrosive nature of the water.

Furthermore, we don't believe that any metals at Yucca Mountain in the tunnel itself have much more of a lifetime than maybe 1,000 years.

We have a great deal of corrosion data. We actually went into the tunnel, grabbed rocks. We squeezed the water right out of the rocks. We subjected that water to the expected repository conditions with the alloy 22, the canister material DOE wants to do. And we were able to dissolve an eighth-inch thick piece of that material in less than 60 days, completely dissolve it using the same water out of the tunnel.

Now DOE uses their water for these same experiments out of a well that's about six or eight miles downstream through the alluvium. And they use that water for their experiments so there is a vast degree of difference between our experiments and those of the Department of Energy. Can we have the next slide, please.

COMMISSIONER BYRON: Excuse me. I just want to understand that previous slide, if I may.

MR. LOUX: Sure, go ahead.

COMMISSIONER BYRON: The units on the left side are millirem per year.

MR. LOUX: Correct.

COMMISSIONER BYRON: It looks like it's peaking on the 95th percentile curve up around 2,000 or 3,000.

MR. LOUX: It's about 2,500 years it looks like, yes.

MR. HALSTEAD: Isn't that 25,000?

COMMISSIONER BYRON: Twenty-five thousand millirem per year?

MR. LOUX: No, the time frame is 2,500 years and the dose is around, the peak dose is about 100 millirems at that point.

COMMISSIONER BYRON: And that's total dose? That's what I'm trying to understand, the units on the left side of the curve here.

MR. LOUX: The left side are, yes, it's a log and it's at 0, 10, 100 and 1,000 up the scale.

COMMISSIONER BYRON: But millirem per year per what? Per capita? Per Yucca Mountain? What is that?

MR. LOUX: It's the releases.

COMMISSIONER BYRON: That's the total release.

MR. LOUX: Release.

COMMISSIONER BYRON: Okay. And who did this data?

MR. LOUX: This is actually from the Department of Energy itself.

COMMISSIONER BYRON: Okay, thank you, sorry for the interruption.

MR. LOUX: No problem.

So I guess the point I am really trying to illustrate is -- and I'll talk a little bit about the EPA standard in a moment. But as Allison indicated, the EPA standard in draft form is a million years. So when you have a repository that is entirely dependant on a metal container in a highly corrosive, water-laden environment you can see pretty clearly the problems in trying to meet any long-term release standard.

Now the Department of Energy and the state both have data which shows that once the material leaves the container it begins showing up in existing drinking water wells in Amargosa Valley within 50 years. So the key is the container. And if the container fails there is no backup, there is no redundancy. And this is why we believe is fundamentally unlicensable and won't be able to be licensed in the future. Can we turn to the next one. One more.

I want to talk a little bit about the EPA standard just for a moment since it came up in a couple of questions and I do happen to have a slide or two.

EPA has proposed a rather unique standard in the sense that it proposes boundaries, compliance boundaries, that are much different than what you'd expect at WIPP or any other location. They nominally nominate a five kilometer boundary all the way around the repository except on the expected flow path, which is south. And at that point the boundary becomes 18 kilometers. It just happens to coincide also with the boundary of the Nevada Test Site land that DOE controls.

So what EPA had to do in order to try to get the site through the licensing process is essentially jury-rig or gerrymander a compliance boundary that was much akin to what the Department of Energy actually wanted to -- I mean, what their data is showing relative to flow and flow paths in the water table. Can we have the next slide.

So we get to the EPA standard. I want to kind of summarize it briefly. Go on to the next slide.

EPA has proposed a million year standard as you might know and it is bifurcated in the sense that it is a 15 millirem standard for the first 10,000 years and for the post-10,000 years out to a million the balance is 350 millirem.

Now the point I want to make here is this is probably the big difference of why the EPA standard isn't coming out as it might. EPA proposed using the median number of computer runs and the median numbers in order to come to the 350. So it's 350 based on median. I hate to get into statistics. As you know median is the middle, as opposed to the average which would be the mean.

The National Academy has proposed and directed EPA to use the mean and they were one of the reasons -- this wasn't the issue that the standard was thrown out, it was the compliance period. But part of the NAS's recommendation to EPA was the whole basis this data had to be based on the mean and not the median.

If you look at what the mean equivalent is of the median it would really result in doses that may be as high as 1,100 millirems per person using the median instead of mean and that's what this slide attempts to illustrate over time.

What I really am trying to say here more than anything else is that as long as DOE -- I mean EPA sticks to the median this standard will be out of compliance with the court's directive and out of compliance with the Academy and yes, Nevada will challenge it. However, if they do what the court had suggested and they go with the mean numbers then EPA has revealed to us that DOE has told them they simply can't meet that standard.

So one of the reasons the standard is being held up is that Justice keeps telling EPA that you have to propose a standard that is in line with the court's recommendation, meaning using the mean. EPA insists on wanting to use the median of these numbers, which will allow DOE to go forward at Yucca but then it is not in compliance with the law.

These issues are very key to the ultimate success of a repository and ultimately the markers by which the NAS will use -- I mean the Nuclear Regulatory Commission will use to license a repository. So the EPA standard and the accompanying NRC regulations are far from established and likely if EPA comes forward with one that is inconsistent with the National Academy and the court's direction. And Nevada certainly will litigate. Nevada will likely seek injunctive relief to keep the license application from being filed at the same time.

Let me move on to, there's two more I think. This is another one of the mean and the equivalent standards, as you can see. The next one. The next one.

And how this relates to California is obviously any releases to California -- I mean from the repository are going to get into the groundwater. And there you see the flow path of red and blue arrows. The ultimate sink, if you would, for many of these wastes we think, when they're in the water table will be a place called Franklin Lake Playa, which is just south of that Alkali Flats area.

What we fear is going to happen is that much of the groundwater from the Amargosa Valley Basin reemerges and surfaces in some of these dry lake beds. For example, at Alkali Flats and Franklin Lake Playa.

The scenarios where you have now the groundwater contaminated with radioactive materials going through the groundwater system which is flowing very rapidly, surfacing at

Franklin Lake Playa, drying out and then being carried away by prevailing winds all through the southwest. That appears to us to be the worst scenario possible, not only for Nevada but California and other states in the west as well the country. Next one. And one more.

This is a real busy slide and I won't take a lot of time with it but it's important to know. This is DOE's slide from their computer cluster, if you would. This is what it takes to run their total system performance assessment, which is their computer model. To run the actual predictive model of whether the site will meet EPA standards.

This particular model is 6,000 to 8,000 inputs into it. And as you can see it really requires about 552, according to DOE, computers operating in parallel simultaneously to be able to run this model.

Much of the hardware that you can see there is obsolete, it no longer exists. Much of the software is obsolete and no longer exists. And more recently the Nuclear Regulatory Commission staff has indicated that during their licensing proceeding they have no intent of acquiring or running DOE's model. They plan to do spot-checks of DOE's computer model with their own model and not look at it in total.

We doubt that very many people in the Department of Energy can run this model. It probably can only be run by people at their contractor's office. Nevada has asked for the model on numerous occasions, DOE has denied us the ability to look at it. DOE does not plan to have this model ready and any of the inputs to it ready for release until after the license application is filed in June.

There is an administrative requirement at the NRC that all data, all reports and all information, meaning all in the sense of all, have to be ready for the public at least six months before DOE can file a license application. The TSPA as I mentioned, the concept on the TADs, the final designs for TADs, many of the other pieces that DOE wants to use in the license application won't be available until next June at the very earliest. So we would calculate the DOE, even under an ideal circumstance, can't even file a license application because of these administrative hang-ups probably until December or

January '09.

In a sense then if NRC isn't running the model, we can't have the model. There is really no one looking at the model, there is no one minding the store. No one will have an ability to see how this model works and how it predicts or doesn't predict.

I want to close with a couple of comments on the NEPA process. I know that for California and I know local governments in Nevada it is a particularly interesting process. And it limits the public and other people's ability to participate.

The scenario that has occurred already is that DOE has issued a final environmental impact statement for Yucca Mountain. There is a supplement being prepared to deal with some of the surface facilities and there is a transportation EIS that is being developed. My understanding in talking to DOE and the NRC staff is that DOE will finalize those documents and then immediately transfer them to the NRC.

The NRC licensing rights require NRC to adopt as much of the DOE EIS as possible, supplement what need be, and they then issue a decision relative to the EIS at the conclusion of the conclusion of the licensing process.

So there will be no public hearings on the draft that is done in the licensing proceeding. There will be no opportunities for public comment per se and it creates a real problem relative to local governments, the public and other states like California who want to participate in this process, either concerned over groundwater or transportation issues.

Keep in mind that the NRC has no responsibility virtually in transportation other than the approval of the containers that the waste will be shipped in. So any opportunities for people to challenge these EISs may have to be held off until the end of the licensing proceeding some time down the road after, if DOE is successful, they have a construction authorization and are constructing.

Now we're working with our delegation. I know they're working with your delegation to try and get this issue resolved on the Hill. But clearly it is going to be a problem for all of us in trying to figure how to challenge some of the NEPA decision that are being made.

And other than the actual licensing of the repository and the technical science issues associated therein, many of these other issues, socioeconomics, transportation and others, will not be available to provide any sort of challenge until after the licensing proceeding is over and then in court.

But with that I'd be happy to conclude and answer any questions you might have.

PRESIDING MEMBER PFANNENSTIEL: Questions? Comments? Thank you very much.

MR. LOUX: Thank you.

PRESIDING MEMBER PFANNENSTIEL: We appreciate your being here. Bob.

DR. WEISENMILLER: Our next speaker, as I indicated, is essentially an afternoon speaker who is going this morning. Alan Hanson was appointed executive Vice President of Technologies and Used Fuel Management of AREVA NC Inc., an AREVA company, in 2005. He also continues his responsibilities as CEO of Transnuclear, Inc., also an AREVA company, which he joined in 1985. Transnuclear designs, licenses and supplies dry storage casks; and more than half the casks in the US have been supplied by Transnuclear.

In terms of, again, hitting very much at a high level, I want to emphasize two other points of his background. One was that in '79 he joined the International Atomic Energy Agency in Vienna and he served first as coordinator of the International Spent Fuel Management Program and later as policy analyst for responsibilities in the areas of safeguards and non-proliferation policies.

And also that he received a BS in mechanical engineering from Stanford University and a PhD in nuclear engineering from MIT. So welcome back to California.

DR. HANSON: Thank you very much. Is this microphone working?

DR. WEISENMILLER: Yes.

DR. HANSON: Okay, good. I think that I'll try to use this podium since you set it up. Nobody else has chosen to use it and I'll be a little bit different.

I'm a little bit different anyway because when I look at the panel of people that you have speaking to you today I notice that I am the only one here with an industrial background. Everybody else is coming from government, public interest groups, academia. And there is nothing the matter with that but I have spent my entire career getting things done. And that is the difference between an industrial organization and many other organizations.

I am not here to debate Yucca Mountain. That is something that you will hear a lot about. I want to talk about used fuel management in this country and recycling and how this might fit into a program here in the United States.

The first slide here shows the accumulation of used nuclear fuel in the United States. There are a couple of important factors that come out of this figure. First of all you can see the growth of the used fuel inventory in the US. It says it's 55,000, actually it's closer to 56,000 today, it's growing that fast. It's growing at 2,000 tons a year. So the numbers go up fairly quickly.

But very importantly, for all the discussion of a nuclear renaissance, it adds little to our used nuclear fuel problem in the first half of this century. The problem is with us today, if we want to call it a problem. It is going to remain with us. If we don't build any more nuclear reactors we still need to deal with this issue. The spent fuel that will come out of future reactors does not come out for decades and so this is not really a nuclear renaissance issue.

The ultimate disposal of the commercial and defense waste is an absolute must. It's an ontological problem. This is something that must be done, And because it must be done it will be done. How we go about doing that we can debate. We have been debating for well over 30 years and I suspect we will debate for a long time to come.

The question is regarding recycling. I heard it said earlier by your consultant that reprocessing is not necessary for the fuel cycle. And that is correct but it is really answering the wrong question. The question is not is it necessary, the question is, is it useful and/or desirable. And that is the question I am going to address and I would answer, I can tell you in the positive.

In order to get the repository finished, we've already heard from Eric Knox, we need licensing reform and legislation. Whether or not that is going to come, I am not going to address that here. I am going to just deal with what we are doing today and what we could do in the future. Next slide.

Our existing fleet of new reactors. One hundred four operating reactors were designed with small storage pools with the expectation the fuel would be shipped offsite for reprocessing. That didn't happen for policy and economic reasons so what do we do next? Virtually every reactor in the United States chose to rerack their spent fuel pools because that gave them more space at the least amount of money and it was thought to be necessary only for a short period of time.

In theory you could expand a wet storage pool and make it bigger but the civil engineering problems associated with that have made that an option that no one has implemented.

You could trans-ship from one reactor to another. But this doesn't solve the problem, it just moves the problem from one place to another. And so very little of that has been done.

So the industry has come down to one interim solution, that is to ad dry storage casks at the reactor site. Next slide, please.

Now as we look at today there are, we are approaching 500 storage casks in operation in the United States, some of them here in California as you know, and more to come.

If we stretch out in time and look at the next decade I have got some projections for the years 2010 and 2015. These are fairly reliable projections assuming that the reactors continue to operate at their current levels of performance. The important factor is that by 2015, and we won't have a repository at that point in time, 40 percent of our spent fuel or more is going to be in dry storage rather than in the spent fuel pools themselves.

This is a growing and it is a mature industry. It is a short-term band-aid, it is not a solution. One of the things which I find quite disturbing is when dry fuel storage is painted as an alternative to disposal. It is not disposal, it is just something that we're doing because we have to do. Eventually you have to take the waste products and you have to dispose of them in an environmentally satisfactory way.

And I want to agree with every one of the previous speakers, a repository is going to be necessary regardless of whatever fuel cycle it is that we decide to adopt in the United States.

There is no magic cycle which eliminates the need for a repository. Whether or not it's Yucca Mountain, I don't want to get into that debate, but we will need a repository.

So what do they look like? There are two types of systems for dry storage, one is vertical and one is horizontal. The one on the right, which is horizontal, is the one that my company provides. It is in implementation today at Rancho Seco and at San Onofre. The one on the left, the vertical silo, will go into implementation at Diablo Canyon. Both of these are sturdy, robust, safe and relatively inexpensive.

Now we're looking at the nuclear renaissance and we're looking at what we need to do to go forward to build new reactors and to add nuclear generation to the mix.

Is the fuel cycle strategy that was adopted some years ago, what I would call a throw-away strategy, the correct one. It was certainly okay at the time because when the strategy was adopted we thought there were only going to be -- there were going to be 100 reactors, they were going to operate for 40 years, they were going to shut down. So there was really no need to do a sophisticated back-end of the fuel cycle. that's one of the reasons that it was abandoned.

But today if we have growth, and particularly on a worldwide basis, is that an adequate strategy. Is throwaway really the best thing to do? If you're an environmentalist someone ought to start asking the question from day one, is it a good idea to throw away anything that still has some use. Next slide.

So why treat and recycle used nuclear fuel? There are a variety of reasons why this could be found desirable. It can be protective of the public health, safety and the environment.

Very importantly, it can maximize the amount of material recovered from the used fuel for use in reactors and at the same time by minimizing the volume and the types of materials which go into the repository.

The uranium can be recovered and recycled. The plutonium that has been generated in the reactors has an extremely high energy density and is a very valuable product from the point of view of its energy conservation aspect.

All of this needs to be done in a

fashion that does not contribute to proliferation risks and it should be done as economically as possible.

But I would point out that if you recycle all of the uranium and plutonium in the used fuel that is out there today you conserve approximately 25 percent of the natural resources. Which in this case is the uranium. That's 25 percent of the mining, the milling and the enrichment that goes away. You don't have to do it. And as a result of that you have made a contribution to environmental protection. Next slide please.

Now we aren't doing it in the United States but we are doing it in other places in the world. And I am going to speak a little bit here to my own company, AREVA, and what is being done in France.

What you will see here is the reprocessing, the treatment of used fuel that has taken place in the La Hague reprocessing plant in Normandy in the north of France. As of today we have reprocessed more than 22,650 metric tons of used fuel. Now that is almost half of all the fuel that has been generated in the United States today. It's a big, big amount of fuel.

Interestingly, in order to do that the shipments of used fuel to La Hague have exceeded 3,000. We are well over 3,000 shipments of used fuel to La Hague. Every one of those shipments was multi-modal and not one of them has resulted in any accidental release of radioactivity. Transportation of used fuel is a common, ordinary business in Europe today, also in Japan.

You also notice in there that among the items that has been reprocessed is MOX fuel, which is the recycled fuel that has been run through reactors twice. We have done that to prove to ourselves that it can be done. We have also managed to reprocess fast reactor fuel. We know that that can be done. Next slide, please.

So where does the fuel come from? This is the list of countries from which the fuel has come to the reprocessing plant. Primarily from EDF, the national utility in France, but also Germany, Japan, Switzerland, Belgium and the Netherlands.

I don't have a slide here to address this but I am going to interject something because it's current news and I think it plays very well to your deliberations. In May of this year AREVA entered into a contract with a consortium of Italian utilities. Italy shut down all of its nuclear reactors after the Chernobyl accident. They're the only country that shut down all of their reactors. The spent fuel remains in the pools on-site. They started to put some in dry storage and decided they didn't want to continue doing this.

AREVA signed a contract with these utilities in May to take all 235 metric tons of fuel from Italy, to treat it at our La Hague facility to recycle the uranium and plutonium in other reactors in Europe, because obviously it can't go back to Italy, they have no operating reactors. The waste will be vitrified, as it is in France, and the vitrified waste will be returned to Italy along with the cladding hulls no later than 2025.

This will basically eliminate the spent fuel issue in the country of Italy in its entirety. And this is an interesting example of what could be done if someone was to choose to do it. Next slide please.

The waste volumes. There's a lot of

mythology about waste volumes and some of it is definitely not true. I want to show you the waste volumes. On the right hand side is the waste volume of using direct disposal of used fuel. This is a canister of used fuel assemblies which contains 100 percent of the plutonium which has been generated. That stuff doesn't go away, by the way folks. There are only two ways to get rid of it. Wait for it to decay or fission it.

On the left hand side is what that waste form is reduced to at La Hague. The bottom element, the vitrified waste, is the glassified fission products, which does contain some small quantities of plutonium and transuranics and the compacted waste hulls and end fittings from the fuel assemblies. And you will notice this is significantly less than the volume of the fuel assemblies.

Now what is not included on that slide, and for good reason, is the uranium. If you include the uranium in there obviously you haven't made much of a change because the uranium represents the largest quantity of material in the fuel assembly. But that is being recovered for recycle. And at $136 a pound for uranium I can tell you that will be recycled. It is being recycled in France today and EDF is going to step up their program to do it because of the value of uranium in the international market,

It also doesn't include the low-level contaminated materials, rags, clothing and things that you produce whenever you handle radioactive materials, but this is a relatively innocuous form of waste. It can be dealt with, it is being dealt with. In fact it is the only material which we are actually disposing of in the United States today in shallow land burial. And if it is transuranic contaminated, as this material would be, it could go to WIPP in New Mexico. So the next slide.

This is just a little more detail on the waste forms themselves. I'm not going to go through the numbers on this. But what you see is that you produce a very small quantity of material which needs to go into a repository. It's the vitrified waste and the compacted metal products. The short-lived materials can be disposed in near-surface burial.

And you see there that for all of the spent fuel that is being treated at La Hague we are producing about 2,000 cubic meters a year of this low-level waste, which is a very small number compared to the tons of material going through the factory. The next slide.

One of the reasons that this is being done is because it reduces the toxicity of the materials going into the repository. It makes it easier to dispose of them for the long-term. The top slide on the right shows the components of radiotoxicity that is in the material. The top one there is the used fuel and so is the bottom one.

You will notice that the fission products in the lower left hand corner in red decay very quickly. They go away in 100 to 300 years. And after that the single biggest contributor to toxicity is plutonium and its daughter products. Removing that material from the fuel, recycling it and burning it up is a positive step in terms of the repository and also in terms of non-proliferation objectives.

You can see it even more dramatically on the lower slide because all of that green in the middle is the toxicity associated with the plutonium over time. Next slide.

This is very schematic and there are no numbers attached to this o any significance. Using the blue line, which is the natural uranium, the toxicity of natural uranium ore as some sort of a benchmark, the highest curve here is spent fuel containing all of the minor actinides, the fission products, the plutonium. And you notice that you don't get a crossover toxicity with the ore until you get out in the million year time frame. This is the problem we're dealing with today in trying to establish a standard for the repository.

If you remove all of the plutonium as early as you can in order to avoid having the daughter products then you end up with a curve like this and now we have a crossover point which has been backed down into the 10,000 to 30,000 year range. That is a range that is a little bit more workable and a little bit more defendable than a million years, I would argue.

And of course if one was to get to an ideal situation of removing all the minor actinides as well then you have only the fission products and your toxicity is basically crossing over at about 300 years.

GNEP has been mentioned earlier. I am not here to defend that program either, there are plenty of people who can do that. But GNEP is aiming at trying to get to this particular point over here where you have a very, very, short period of time in which you have to handle the waste products. So next slide.

Responsible used fuel management is a prerequisite to public acceptance. And that's what we're talking about. Because the truth is there is no technical reason why we have to have a repository in operation today. There is no technical reason I can come up with why we need one in 2020, 2050, 2100. There are good public acceptance concerns, there are other reasons to do it, but technically it is safe where it is but it is not the best way to deal with the products that we are left with after we burn the fuel.

Responsible fuel management, including recycling, has the following advantages. It recycles 96 percent of the content of the used nuclear fuel. That's primarily the uranium.

It conserves 25 percent of our natural resources, which means less mining, less enrichment.

It consumes, in France -- these numbers are from France -- less than six percent of the cost of electricity in France. That's a small amount of money when you look at the global costs of electricity.

It reduces the high active material waste volumes by a factor of five.

It divides the waste toxicity by a factor of ten.

And very importantly, it produces waste forms which are far more amenable to long-term stability than the spent fuel assembly itself. Some of the issues raised by Allison and by Bob here are very legitimate issues with regard to the stability and the ability to protect used fuel over centuries and millennia.

A lot of those problems go away when you put it into a glass form which is very, very stable. Our chemists and geologists in France feel quite comfortable defending a 300,000 year time period for the stability of the glass waste we are producing. And by the way, we are producing in this country because glass waste from West Valley, from Savannah River and from Hanford also has to go into the repository.

Treatment is an environmentally responsible choice to make. Next slide.

People will argue that those consequences associated with doing treatment and recycling are unacceptable. That is a very comparative thing. I want to list a couple of comparative items here. If you look at the releases that are occurring from the La Hague facility, these are data from 2003 but they really don't vary very much from year to year.

Those consequences of the entire reprocessing operation that we are doing there is basically comparable to one flight across the Atlantic, a 400 meter increase in altitude. It is trivial in the extreme compared to background radiation and other sources of radiation. It can be done with minimal impacts. Next slide.

Cost of recycling. I find it interesting when the anti-nuclear community and the environmentalist community attacks recycling as being uneconomical. It's a little more expensive than doing a throw-away fuel cycle. If that is our standard for decisions in the energy field then you can throw away all the renewables because the renewables are the most expensive way, with the exception of course of hydroelectric.

We make decisions about our energy portfolio based on more than the absolute lowest cost. We factor into it energy security and supply. We factor into it environmental factors. There are a wide number of factors that need to be accounted for.

AREVA had a study done in 2005 by the Boston Consulting Group which produced the following curve here. Looking at comparing a once-through throwaway with a recycling process somewhat similar to what we are doing in France today.

And the results for that study at that time showed that recycling was a little bit more expensive than a once-through throwaway cycle. But it was in the bounds of what we call comparable economics because it was really plus or minus ten percent and those numbers are very, very flexible, very, very movable.

One of the numbers that we know less about than anything else is this number on the left hand column, which is the cost of the repository. What it's actually going to cost to implement the repository. When we talk about a once-through fuel cycle we're taking numbers off of this left hand scale here and casting them in concrete.

Since the study was completed about a year and a half ago the cost of the repository has gone up. And we can find that in publicly available documents from the Department of Energy.

The cost of uranium was pegged at $31 a pound when this study was done. Today we are at $136 in the spot market. And under long-term contracts some are being signed in the $80 to $90 a pound range. The scale here stops at $58 a pound. When you talk about $136 a pound uranium you're out here somewhere. There is absolutely no question that recycling can be done economically given the parameters that we are dealing with today. Next slide.

We could spend a whole day on non-proliferation aspects and I'm sure you'll hear a lot about it this afternoon. What I want to point out here is just one simple item. And that is, that the MOX fuel, and that is the mixed oxide fuel which includes the plutonium recovered from reprocessing, is far less fissionable, far less amenable for weapons than is UO2 fuel at any point in its cycle. And in particular there was a period of time in the light water fuel cycle when the quality of the plutonium in the used fuel is weapons grade. You cannot get to that point with mixed oxide fuel, ever.

There are non-proliferation advantages associated with doing plutonium recycle. The opponents of recycling don't want to acknowledge this but they in fact exist. I don't want to belittle the problem. This has to be done with high levels of physical protections and safeguards in order to make sure no diversion takes place. It can be done, it is done in France today.

Finally, summary slide. The obvious. Today dry fuel storage is used on a large scale. It is basically the only thing that we are doing today.

Because of the inertia associated with any kind of a large-scale industrial process like this it is going to remain the case at least for the next 10 to 15 years. So if we want to talk about doing something different we don't start seeing the results of that change until about 15 years into the future.

Again, that geologic repository is

necessary regardless of the fuel cycle and we should move ahead as expeditiously as possible. But we need to do it not fast, we need to do it right. We need to pick the right repository in the right place. We need to pick the right waste form, which is being ignored in the debate today, and we need to get that right.

Then finally, domestic treatment and recycling could be a valuable approach to the back end of the fuel cycle but it is not a short term advantage because it would take a length of time to operate it.

Now let me -- Since you asked for the implications for California, what does this mean for California. First of all, the technology for reprocessing and recycling exists and is being done today, it is just not being done in the United States. So if the pure existence of those technologies and a demonstrated ability to do it is part of your sine qua non that is in place as we speak.

US fuel could be treated in the same fashion or a similar fashion. We would do it a little bit differently if we were to start over today. In the short term the only way that that could be done would be to ship the fuel to France or the UK or Japan for reprocessing but that could be done. And then finally you could build a domestic reprocessing/recycle facility and do it here but it would take a lot of time.

And that may or may not be a GNEP-type technology. That's really a Generation Four recycling technology and in some respects it is not quite ready for prime time.

The time scale for entering into a recycling economy is comparable to the time frames we're talking about for opening up of the repository. Whether or not its done is both an economic and a political decision, therefore not one that I will make. And that concludes my presentation.

ASSOCIATE MEMBER GEESMAN: Thank you very much. I have a question on, I think it was one of your first slides, regarding dry cask storage. I think that you were projecting that by 2015 about 40 percent of the reactor waste would be in dry casks. My question to you is, why so low?

DR. HANSON: The move into dry fuel storage is driven by economics and by space available. Since it is always cheaper to use the existing space that is done first. So until you fill up or get very close to filling up a storage pool you don't really move into dry storage. But eventually you will run out of space in the existing, existing pools.

By 2015 out of the 104 operating reactors I would be willing to bet that somewhere between 95 and 100 facilities would be in dry storage. There are a couple of reactors that will never need dry storage but there are very few. But everybody will be forced into dry storage. And it will take a while before the dry storage volumes catch up to what is still sitting in the pools themselves.

ASSOCIATE MEMBER GEESMAN: I see your name prominently mentioned on the acknowledgements page of the Keystone Center's recent published nuclear power joint fact finding report. Do you have an opinion as to what type of weight we should attach to this sort of consensus document?

DR. HANSON: A consensus document is by its very nature something of a wishy-washy document because in order to get a consensus you need to regress to the mean, let me say. I don't think my name, I don't think that my name was prominently displayed. You will find that I was one of the people who was invited to address that panel, as I was invited to address this panel. The Keystone Group chose to ignore almost everything that I said. (Laughter).

I would also, however, point out something extremely important. When you look at that report read the qualifiers with regard to the endorsement. I have already heard a number of people get up and say in public that the endorsements represent the views of the companies on that list. That is absolutely not true. It represents the endorsement of the individuals whose names follow, it does not represent the endorsement of the companies themselves.

ASSOCIATE MEMBER GEESMAN: Thanks very much.

COMMISSIONER BYRON: Dr. Hanson, can you thank you as well for being here today. Can you explain to me why, as I am looking at the plot that shows the annual metric tons of uranium that has been reprocessed, why it peaked in about '96, '97 and why we are seeing a much lower rate now at the facility.

DR. HANSON: Yes. The peak that you se there is the working off of what are called the baseload service agreements, which were entered into by AREVA, at that time Cogema, to reprocess fuels from a number of countries. And very, very importantly, that peak occurred because of the reprocessing of fuel sent from Japan to La Hague for reprocessing.

That campaign was finished at the dash line and no more fuel is coming from Japan to La Hague and that is because they have now completed their own reprocessing plant at Rokkasho Mura. That plant as we speak is going through hot testing and it is the intent of the Japanese utilities to reprocess their spent fuel domestically now rather than to ship it to France. So what you see there. So what you are seeing there is a spike.

The other thing at the far right hand side of the curve you'll see there is an effect from the German program because the Germans are in the process, nominally, of shutting down their program and so less fuel is coming from Germany than had been the case in the past. So those are the two primary reasons.

Interestingly enough what that means when you look at the numbers there is that there is a lot of excess capacity available in the facility to take fuel from anyplace in the world that chose to do recycling.

COMMISSIONER BYRON: Do you expect that capacity to increase then given that we've got what, about 440 operating reactors throughout the world now?

DR. HANSON: It may. That would be speculation at this point in time. Two years ago I would not have expected to take all of the spent fuel from Italy to La Hague. I can tell you that there are discussions, active discussions with a number of the utilities in other countries. And the list of countries sending fuel there I expect to go up over the next few years. I would even, frankly, like to see the United States on that table someday.

COMMISSIONER BYRON: Thank you.

COMMISSIONER BOYD: Could you tell me, what are the countries doing with the vitrified waste that they receive?

DR. HANSON: The vitrified waste is in storage. Again it's interim storage. If you go and visit the La Hague facility in France, and I would be happy to invite every one of the Commissioners to come over and take a look at this fine facility if you want to see how it's done in France.

When the fuel is vitrified into the glass canisters it is then stored in below-ground, concrete silos. The entire waste product from the French nuclear program, which is about 58 reactors, basically all goes into one building. And you can stand on the floor of that building with all the waste from years of generation of used fuel from 58 reactors and it's awaiting the repository as in every other country.

Coming back to what was said by the previous speakers. It's correct, there is not a single country in the world that has an operating repository. I happen to agree with Allison Macfarlane. My bet is -- If I had to make a bet I'd bet on Finland. Maybe Sweden, because the Swedes tend to do things very, very well, although they do it in a gold-plated fashion.

France will probably not be that far behind. We are investigating repository in a clay formation in the east of France. The earliest projection for disposal is on the order of 2025. But historically France has not ben in a big hurry to dispose of the waste because they didn't see the near-term need to do it, particularly in light of the recycling program that is going on right now. They feel that managing the glass canisters on near-surface storage is perfectly acceptable for decades.

COMMISSIONER BOYD: In France do you keep that storage at your facility or does the government have a separate --

DR. HANSON: It stays at the facility. There is no dry storage at any reactor in France.

COMMISSIONER BOYD: Thank you.

COMMISSIONER BYRON: One last question.

COMMISSIONER BOYD: Go ahead.

COMMISSIONER BYRON: How many mussels is 200 grams? (Laughter).

DR. HANSON: A lot more than you're going to eat in one sitting.

COMMISSIONER BYRON: All right, thank you.

DR. WEISENMILLER: Our last speaker for this morning has also returned from the last time. We have Bob Halstead here who has been the transportation advisor to the State of Nevada Agency for Nuclear Projects since 1988. And his primary responsibility in the assessment of Yucca Mountain is transportation impacts.

MR. HALSTEAD: Thank you, Commissioners. It is a pleasure to be here again. I will try not to repeat all of the things that I said two years ago, although unfortunately some of the uncertainties I talked about in the Department of Energy's transportation program then are still major concerns today.

Let me begin by acknowledging my colleague, Dr. Fred Dilger, who ran the DOE-sponsored transportation routing models that we used to generate the route maps that are in the presentation today. As we are late in the day and I promised Barbara that if this happened we would move quickly let's go quickly to slide three.

And if we look at slide three and slide four they show you what is probably intuitively obvious. That the large areas of California that would likely be affected by transportation of spent fuel from the California reactors are primarily in the north and central parts of the state. Those would be relatively small numbers of shipments compared to the total going to Yucca Mountain.

The part of California that would be most heavily affected by the confluence of those shipments from California reactors, joined by the shipments from reactors in other states, would be in the southern part of the state, basically between Los Angeles and the Arizona/Nevada borders. Next slide please.

We've talked a lot about spent fuel. We haven't talked a lot this morning about how dangerous it is and why it's proper management is such an important matter, particularly in the first 100 years after spent fuel is withdrawn from a reactor.

Unlike the radiological hazards we're concerned about in long-term disposal we're primarily concerned about the gamma-emitting radionuclides, and particularly we're concerned about cesium 137 and strontium 90.

Now the bad news is the spent fuel is very dangerous. The good news is that because those fission products have half-lives of 28 and 30 years you very quickly, in geologic time at least, over five decades get an 80 percent reduction in the radiological hazard we're concerned about in transportation if we go from a policy of shipping five year crude fuel, which is allowed in current licensed casks, and if we go to a policy of shipping the oldest fuel. Say shipping fuel that has been cooled for 50 years. Next slide please.

There has been much discussion over the last two years about -- since I reported to you in 2005 about the vulnerability of shipping casks. There has been no change in our assessment of the vulnerability of the casks to attacks involving shake charges or other explosive devices.

There has been a new report by the Nuclear Regulatory Commission on the Baltimore Rail Tunnel fire of 2001. The NRC believes that that fire did not generate sufficient temperature and duration of a fire to compromise casks that are currently licensed. Our analysis suggests otherwise but we have not published yet a response to that final NRC report and we hope to do that in the next year.

I would argue that those types of fires are very rare in the accident environment. And that regardless of whether you believe the NRC's analysis of the fire or Nevada's analysis of the fire, the most important thing here is to find a regulatory way to eliminate the likelihood of a cask getting into that type of a fire.

So while this technical debate over what this fire was capable of continues, in fact having done this analysis the NRC has endorsed shipping spent fuel in dedicated trains as one way of eliminating the possibility of these types of fires.

Subsequently the Association of American Railroads has adopted a protocol recommended both by the NRC and the National Academy of Sciences to basically prohibit trains carrying spent fuel from being in single-bore dual track tunnels when shipments of explosives or flammables that could create an environment similar to the Baltimore fire would occur. So in this case maybe the resolution of the technical debate is less important than the fact, and there's an agreed-upon safety enhancement on how to deal with those types of fires. Next slide.

This summarizes our safety concerns. Documentation is available at our website.

Let's go to the next slide and talk for

a moment about the National Academy of Sciences special study committee on spent nuclear fuel and high-level waste transportation, which completed almost four years of work with its report in 2006.

And basically I think the title they chose for their report, Going the Distance?, reflects the position that the State of Nevada has raised relative to the Department of Energy's transportation program where we have said consistently, the question is not can it be done safely, acknowledging that safely means there is always some quantifiable risk, but the question is will it be done safely based on the facts of the program that DOE has put on the table. And that's where our concerns lie.

And if you take the time to actually read beyond the summary of the points in the NAS report, and I strongly urge that you do that, you will see that the National Academy has provided a very important opportunity for a consensus among most of the parties who have been active on the transportation safety and security debate.

The parties as far apart in many ways as the Nuclear Energy Institute and the State of Nevada and some of the environmental groups and some that I think would openly call themselves anti-nuclear groups.

And that is that the National Academy took the position that while there aren't any fundamental barriers to safe transportation this is not the same as saying that everything is okay. And the Academy strongly recommended both additional safety measures and an independent assessment of the terrorism risks before any large scale shipping campaigns should occur such as the shipments to Yucca Mountain.

Additionally the Academy examined many of the institutional complications within which the DOE transportation program operates and suggested that before a large scale campaign like Yucca Mountain it would be prudent to consider taking the DOE transportation program out of the Office of Civilian Radioactive Waste Management and possibly taking it out of the Department of Energy altogether. And this is perhaps influenced also by a consideration as the committee did of lessons learned with the programs in Europe. They were particularly I think influenced in this regard by the operation of the program in Sweden.

The next slide and the next slide brings us to a second safety issue where there is a agreement, but not complete agreement, between the State of Nevada's position and the National Academy. The first one is shipping the oldest fuel first. That is really the most direct cost-effective way to reduce the radiological hazards in transportation.

Secondly the NAS committee was rightly impressed by the rigorous standards that the NRC packaging performance requirements in 10 CFR Part 71 combined with the counter-terrorism regulations in 10 CFR 73 provide.

Now understand that the NRC's regulation of the DOE transportation program is very strictly limited by the NRC's peculiarly minimalist reading, in my opinion, of the Nuclear Waste Policy Act of 1982 to only deal with the cask performance standards, which address a cask surviving hypothetical accident conditions.

And these are the nine meter drop, the puncture test, the 30 minute regulatory fire and immersion. The problem is that no casks currently in use, nor the casks being planned for Yucca Mountain shipments, have ever been subjected full scale to these tests.

Now we can debate the pros and cons of this and I am happy to discuss that in question and answer. Let me put it this way. Next slide.

The very gold-plated, to use Alan's word, testing program that the State of Nevada recommends, which we believe would go far to resolve the public concerns about cask performance, would, based on our calculations, cost about $70 million. And this is compared to a transportation cost based on DOE's and Nevada's calculations that certainly be in excess of $7 billion. More likely in excess of $9 or $10 billion over the life of the repository.

So while good, meaningful cask testing is going to be expensive it is relatively inexpensive compared to the overall cost of the transportation program and is a major factor in public concern about safety.

Now let me turn to the next slide and just point that while the Department of Energy originally put forward a proposed action plant for Yucca Mountain of 24 years based on the projected 70 metric ton capacity they are now asking in legislation for the lifting of that cap.

And so I think looking at the

transportation, the life cycle of the transportation program, we should look at it as what DOE is actually asking for, which is basically a four decade program to move somewhere in the neighborhood of 130,000 to 150,000 metric tons. Next slide please.

Here I have just shown some of the differences between the scale of the future shipments, which basically would be about three trains per week and two truck casks per week, if most of the shipments are by rail over 40 years. or eight trucks a day if this were all moved by truck over 40 years.

And we're talking about an enormous increase both in the amount of spent fuel shipped, possibly the number of casks shipped depending on capacity issues that haven't been resolved, and certainly a big change in the shipment characteristics.

And this is one of the reasons why we have often argued that the European experience, while it is interesting, is not as useful as you might think. About three-quarters of the international shipments by land occur in the United Kingdom and France and they are less than a third average distance what cross-country shipments in the US would be. And most of the long-distance, transport shipment in the world is as mentioned earlier, water-borne shipments, whether they are from Japan or in Scandinavia. Next slide please.

Turning to the California reactors. I'm sure everyone on the Commission is familiar with them and I will try to summarize in the next two slides. If we could see the next slide and the next slide, these are the expected number of cask shipments to Yucca Mountain from the California reactors.

And to make a long story short, if it's mostly by rail an it is three casks per train we're talking about four to six trains per year. If it is all by truck we're talking about 70 to 100 trucks per year in order to handle the California spent fuel. Next slide please.

Now in my presentation two years ago I identified a number of uncertainties in the DOE transportation program and unfortunately most of these still exist. In that time DOE has considered a new rail construction option for Yucca Mountain, a so-called minor route. Now they seem to have taken it off the table. We won't know until October when their draft EIS comes out.

But certainly there is still no ability to be certain about rail access to Yucca Mountain. And in those two years DOE's own cost estimate of building the railroad has gone from $800 million to $2 billion.

There is still no comprehensive transportation plan, although Director Ward Sproat promises we'll see one this summer.

There are perhaps even more uncertainties about packaging because of this proposed transport, aging and disposal canister which the utilities have mixed views about.

There is a realization in the utility community, I think at DOE, that even if they get rail access probably ten percent of the shipments will be made by legal-weight truck anyway.

And finally, there is a new fly in the ointment. The so-called suite of routes approach to picking routes, which is what I want to focus on in most of my remaining comments because this affects the percentage of the shipments that would likely come to California. And parochially from Nevada's standpoint, the percentage of rail shipments that might go through downtown Las Vegas on their way to the proposed Caliente rail spur. Next slide.

Now just to show how difficult the rail, mostly rail system is. There are 24 sites, including Diablo Canyon, where rail, direct rail access is either impossible or difficult. And one of the proposals DOE has floated is the notion of using barges to ship to Port Hueneme. Next slide please.

Let's say DOE builds a railroad and they succeed in moving 90 to 95 percent of the civilian spent fuel by rail, which seems awfully optimistic to us. Gary Lanthrum used the word misrepresentation in talking about information about California's shipments. And if that is aimed at me I will respond to it directly.

We have been trying to get the Department of Energy to say what their preferred routes were for about 20 years now and they continually find ways to push back and obfuscate the issue because they don't want to deal with it.

And it is clear from their latest schedule they prefer to push it back until after the NRC is actually considering the license application so that whatever other complications they have they won't have the affected transportation states involved in challenging their license at the NRC.

The thing I would point out with rail is there are no federal routing regulations so you are reliant upon the routes the railroads use unless the shipper, in this case DOE, decides to dictate those routes in its contracts with the carriers. And that is the approach that the State of Nevada has recommended for the better part of two decades. That DOE find the safest routes and designate them in the rail contracts.

Now with highway routing it's a little different. There actually are routing regulations from the federal highway administration.

Now in referring to my 2005 statement to you I show what we call a southern consolidated routing strategy, which would bring all the rail and highway routes down into Oklahoma and then use this corridor along I-20 and the BNSF and then bring those shipments in to Caliente.

That's where, next slide, my maximum impact number for California comes from. The minimum number is the number that DOE discussed in its 2002 EIS, which showed most of the shipments coming in from the east. But then when we asked DOE if those were the routes they really planned to use they said well no wait a minute, those are just representative routes we did for purposes of analysis. So if we could go back to that last slide, that one again.

Our current estimate is that the best way to understand what is likely to happen under the so-called suite of routes approach is that there will be two northwest routs by highway and rail and there are connectors here in the middle. The southern reactors, if necessary, could travel on the northern routes, the northern routes could travel on the southern routes. But this is the best way of illustrating what we think is the most likely lifecycle approach to transportation.

In which now, if we could get to the next slide, the projection again, we're basically talking about 40 to 50 percent of the rail shipments, or next slide, the truck shipments to Yucca Mountain coming through California under the most likely routes. And again just to quickly look at the truck routes.

Interestingly, since DOE studied this

the State of California succeeded in blocking the use of I-70 as a cross-country route, arguing successfully concerns about shipments through downtown Denver and through the Glenwood and Eisenhower tunnels in the mountains. So now we believe that these shipment would be split along the I-40 and along the I-80 corridors. Next slide.

And the next slide basically will show you now whether we look at 24 years or 38 years, looking more or less at about 45 percent of the shipments to Yucca Mountain going through California. Next slide please.

We have to go to the second show I think. Too many megabytes to send these beautiful graphics through. Okay.

So I want to just call your attention to three of the locations in California that are likely to be heavily impacted. One is the San Bernardino area where there is a confluence of rail shipments if the shipments are mostly by rail from the California reactors and some of the out-of-state reactors. Next slide, please.

The Cajon Pass area, where there is a confluence of truck and rail shipments where I-15 runs next to the Union Pacific main line. And then the next slide.

At Barstow, which we could I guess call the ultimate confluence of all these streams of both truck traffic and rail traffic. It just is one way of identifying using these Google Earth depictions how these impacts would actually fall on specific locations. Next slide please.

In summary, as Bob Loux said, it isn't clear how these issues will be discussed at the NRC. Partly because the NRC has said they have a limited role in transportation and partly because of what appear to be restrictions on the early phase of discussions, public discussions of what DOE submits in its license application.

So we would suggest that California continue to look very seriously at the opportunity that we will supposedly have later this summer to file comments on DOE's Draft National Transportation Plan.

And in October there will be two separate NEPA documents, both of which are important to California. One, the draft rail alignment EIS. But also there will be major transportation implications in the supplemental

EIS which looks at the implications of this TAD canister system.

Thank you very much and I'll be happy to answer any questions you've got.

ASSOCIATE MEMBER GEESMAN: Thank you. Commissioner Byron.

COMMISSIONER BYRON: Yes, thank you as well for being here today. You had said something earlier and I didn't quite comprehend the assumption. Why only three casks per train?

MR. HALSTEAD: It could be as few as one or two, Commissioner, as many as four or five. It will have to do with the particular arrangements made between DOE and the shipping utility that will reflect whether DOE comes up with hardware that can take canisters of fuels directly out of the dry storage installations, which at this point they cannot, or whether they can only load canisters from a spent fuel pool, which often has to be scheduled around a plant refueling schedule.

Certainly we would not expect any humongous, large trains of spent fuel. The largest number that I have heard talked about is five casks per car. Then additionally you'd have five or six buffer cars and an escort, a specially designed escort car to have security and health physics people traveling with the train.

But most likely it looks like it will be three casks. Whether they're long, long-distance trains per train or whether they would be coming from a particular utility, one of the four sites in California.

COMMISSIONER BYRON: If I may just to explore that a little more. I'm trying to understand where that assumption is coming from. Is it just a prognosis? It's not a limitation that is being imposed.

MR. HALSTEAD: It has to do partly with the way that the shipping queue is organized. It's very peculiar. It's actually organized chronologically around batches of fuel from the time they were dispatched and there is a historical pecking list. Now there may be some buying and trading of spots in the queue among the utilities over that.

And I think the other issue is -- Think about it like this. Three of these large rail casks more or less represent an entire reactor core. So when you ship a train you're in effect shipping the three-thirds of a core that would have been rotated out in sequenced refueling.

So I don't have a better answer than that but I think everyone has pretty much -- It is conceivable if you had a centralized storage facility or if you had a reprocessing facility and you were making less frequent shipments say from a reprocessing facility to a repository or from an MRS facility. That would certainly change, could change the equation. And then you might go up to ten casks per train.

COMMISSIONER BYRON: Thank you.

ASSOCIATE MEMBER GEESMAN: Thanks very much. The schedule calls for a lunch great at 12:30. I do have four blue cards from individuals that intend to address us during the public comment period, which is currently scheduled to be at the end of the day, perhaps as early as 3:30. I want to extend the opportunity to any of those four individuals, or anyone else that would care to address us today.

I am not inviting you to say something that you are going to repeat again at the end of the day. I am not inviting anybody to try and get two bites at the apple. But if there is anyone that would care to address us now. Yes sir.

MR. WILLIAMS: I would like to have two bites at the apple because I came prepared --

ASSOCIATE MEMBER GEESMAN: Please come to the microphone and identify yourself for the transcript.

MR. WILLIAMS: I am Bob Williams. And I came prepared to present the statement of Mr. Brandt to the Commission and I will present that at 3:30. I have some extemporaneous remarks that I would like to make --

ASSOCIATE MEMBER GEESMAN: Okay.

MR. WILLIAMS: -- based on the comments from this morning.

ASSOCIATE MEMBER GEESMAN: Go right ahead.

MR. WILLIAMS: Let me remind you that I appeared at your 2005 hearing and my name was cited in the back. I don't know if there were two Robert Williams, one from a Washington environmental group and myself or whether there's some misunderstanding but I am Robert Williams.

I had 40 years of experience in nuclear energy, ten with General Electric, twenty with the Electric Power Research, eight consulting for the Department of Energy at Hanford.

At EPRI I along with a colleague, Ray Lambert, sponsored the development of the dry storage systems. I personally since my retirement in 1994 still stayed active by being a member of the board of directors of Waste Management Symposia that runs an international meeting each year in Tucson.

I would commend the proceedings of that meeting to your contractor and to the Commissioners. There's a lot of statistical data.

There are two or three key points that I would like to make. I'm appalled that nobody will take credit for the fact that the Waste Isolation Pilot Plant is a nuclear waste repository that has been licensed. It has been licensed to dispose of over 4,000 kilograms of plutonium. It was licensed in approximately 1999 and has been through one rehearing. It's a repository in salt.

The Assistant Secretary of Energy cut a deal with the State of New Mexico to take the spent fuel out of the second floor out of that repository and that is the only reason it isn't an operating high-level waste repository. It is a political constraint, not a technical constraint.

With respect to reprocessing. I'd

certainly endorse the remarks of Alan Hanson. I think there is a simpler example. Do we all continue to dispose of plastic bottles in our refuse or do we pay a little bit extra to take plastic bottles out of our refuse. We don't take plastic bottles out because it's necessarily cheaper but because it's an environmentally sound way to proceed. So we have the technology.

The third point I would make is that the United States has tried being a dog in the manger for 30 years, hoping that people would follow us in not reprocessing if we did not reprocess. Instead we see six or eight major countries continuing with PUREX reprocessing, which arguably is the most difficult of reprocessing technologies to make proliferation resistant.

So I would argue that the United States in trying to make the world safe for democracy and a whole bunch of other things needs to pioneer these more diversion-resistant reprocessing technologies. That won't happen if we don't have a market for nuclear power and a need to proceed with it. And it should not be decided on the basis of cost per se.

Now the final point, I'd like to commend to you one of the very last pages in the contractor's draft report. I couldn't agree with it more wholeheartedly. It is on page -- the folded down corner got away from me. There it is. It cites the economic advantage of nuclear power. The savings to citizens of California from generating only 13 percent of the electricity in the state from nuclear power. And it is based on replacement energy costs. And let me just quote item number one:

> "The direct benefit of obtaining energy and capacity from California nuclear power plants is on the order of 1.5 to 2.5 billion per year as measured by the cost of replacement energy."

Well I think the actual costs of natural gas and other replacement energy has even been higher than has been used in this draft report. So if we were to double the amount of nuclear power in California, having roughly 26 percent instead of 13 percent, we would almost pay for the cost of a reactor each year in terms of the cost of replacement energy saved. Now those are very substantial savings.

The arguments over spent fuel storage and over reprocessing and over transportation in many cases are an excuse, not a reason to be opposed to nuclear power. These are vulnerable issues. I happen to agree with --

I hope you have seen from Eric Knox's testimony and from Allison Macfarlane that we have a potential 30 years war on our hands with respect to licensing Yucca Mountain. There are enough technical issues that I bet it would be unlikely if any of us are alive when they resolve the licensing proceeding.

And it is due to arrogance and hubris on both sides. The DOE doesn't, can't let go of it and the State of Nevada has certainly got people by the short hair, if not by more private parts. (Laughter).

So we need to look at WIPP and not at Yucca Mountain for the issue of availability of disposal technology. Thank you.

ASSOCIATE MEMBER GEESMAN: Thank you. And let me say that although this is a little older crowd than normally come to our hearings I certainly hope most if not all of us are around in

30 years.

We'll take a lunch break until 1:30.

(Whereupon, the lunch recess
was taken.)

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AFTERNOON SESSION

PRESIDING MEMBER PFANNENSTIEL: All right, I think we are ready to reconvene. If the people will take their seats I will turn it over to Mr. McClary.

MR. McCLARY: Thank you. As we referred to this morning.

PRESIDING MEMBER PFANNENSTIEL: Steve would you check the mic and sure it goes on and you're close enough to it.

MR. McCLARY: Is that better? We referred this morning to the re-emergence, reprocessing, recycling technology is something that there's been renewed interest in over the last few years. And we had a foretaste of that with Alan Hanson's presentation this morning.

That'll be much more of the focus this afternoon talking about reprocessing technology, what drives that, the non-proliferation and economic impacts.

We referred to the Global Nuclear Energy Partnership, the DOE program that is leading or sparking much of that discussion. And today we have Tim Frazier of Department of Energy here with us.

Tim Frazier is the senior technical advisor to the Assistant Secretary of the Office of Nuclear Energy. Prior to that he was the Associate Deputy Assistant Secretary in the Office of Fuel Cycle Management under which the Global Nuclear Energy Partnership is managed.

Tim has over 17 years of experience with the Department of Energy managing nuclear programs and operations both in the field and from headquarters.

He previously managed the assembly testing and delivery of nuclear power systems for both space and national security. And with that we'll go ahead.

MR. FRAZIER: I think I'll use this podium as well. I want to thank you first for inviting me. We in the Department seldom turn down an opportunity to talk about GNEP. So we're happy to come and talk about it.

Next slide. First of all I need to put in context. GNEP is much more than just a reprocessing endeavor. It's much more than recycling. It's a global nuclear partnership that's going to address several different things. And I'll run down through these slides, not the least of which is proliferation. And I'll talk about that when I get there.

Next slide. The global demand is anticipated to double by 2050. You can see from this chart it grows exponentially.

Next chart. Earlier this morning we heard about the number of reactors already in operation across the globe generating electricity. Right now there are 436 in use. Browns Ferry 1 being the additional one.

There are 28 under construction and 222 planned across the globe. This is already underway. This is underway whether we are involved and engaged in this process or not.

So what's the Global Nuclear Energy Partnership? Next slide, sorry. GNEP was rolled out in February 2006 with the president's '07 budget request. It is part of the Advanced Nuclear Energy Initiative of the current administration.

Funding in '07 was about 168 million. The '08 budget request is 405. And if you have been following the House mark of the Office of Nuclear Energy budget you'll know that there is still some convincing we need to do on the Hill.

Next slide. GNEP is part of a broader US National Security Strategy. The United States -- and this is out of the National Security Strategy from March of '06.

The United States will build a global nuclear energy partnership to work with nations to develop advanced recycling, i.e., non-PUREX, not the separation of pure plutonium.

This initiative will help provide reliable, emissions-free energy without separating plutonium that could be used by rogue states or terrorists to make weapons.

And these technologies we envision will make broad, sweeping advancements in spent nuclear fuel management and enable the growing energy demand to be met without fossil fuels.

Not without fossil fuels but certainly displacing a large amount of fossil fuel.

Next slide. The rising energy demand is one of the key tenants that GNEP is working to address. There are environmental concerns, greenhouse gas emissions.

And we talked about spent nuclear fuel disposal, proliferation concerns and the effective use of the nuclear energy resources.

Alan Hanson this morning indicated that there is quite a bit of energy left in the nuclear fuel that we would be disposing of in Yucca Mountain if it was once-through intact.

The chart to the side is a very telling. That's a life-cycle assessment of greenhouse gas emissions. And you can see coal is the largest one there and natural gas. And then nuclear, hydro, wind are all about the same level.

So nuclear energy, in and of itself, even if you include the entire life-cycle assessment still has a significant savings over many fossil fuels.

Next chart. This is simply to illustrate that GNEP is not just reprocessing. GNEP is nonproliferation. It's international and industry partnerships. It's technology development, the long-term management of spent nuclear fuel. And, of course, meeting the global energy requirements. And domestically the projected requirements here in the United States.

Next slide. So internationally what is GNEP all about? Well GNEP is all about giving emerging economies, emerging countries that are looking to expand their electricity generation capability. Giving them an alternative to perhaps establishing their own, indigenous, uranium enrichment process, then their own, indigenous, reprocessing capability.

So we're going to establish among nations that are willing to forego uranium enrichment and therefor the processing. We're going to demonstrate these advanced reactors. Develop IAEA safeguards. And then promote the ending of the separation of pure plutonium, i.e., that's the PUREX process.

ASSOCIATE MEMBER GEESMAN: If I can interrupt.

MR. McCLARY: Certainly.

ASSOCIATE MEMBER GEESMAN: How do you intend to enforce the forbearance against enrichment?

MR. McCLARY: That's a very good question. Certainly in using, we'll use Iran as an example in this case. I think the enforcement would have to come from the global community.

Certainly if GNEP was in place now with this kind of fuel supplier, fuel user regime, it would be relatively straight forward for us to go the entire community and say, obviously Iran is not enriching uranium for their civilian use. There must be some other use because we have this backstop of the global fuel supply.

Then it would just be a global, worldwide pressure on those countries to honor the commitment that they made.

ASSOCIATE MEMBER GEESMAN: So you don't envision a regime of binding, legal obligations.

MR. McCLARY: Well at this point we haven't gotten to binding, legal obligations.

ASSOCIATE MEMBER GEESMAN: Okay.

MR. McCLARY: So GNEP international. Next slide. We're doing policy engagement, framework development. This goes much to what you just discussed.

We're doing technical collaborations which have been in place before GNEP was rolled out and are now in place and being further developed.

Japan, France, Russia, China, IAEA, UK were all in Washington the 21st to have the first really large partnership formed. This is the P5 plus Japan. The UK was there as an observer because they haven't quite worked out their government position on nuclear.

Okay, next slide. So domestically there are several things. Expanding nuclear power, I'm sure you've heard of the 2010 Program. I won't go into it here because frankly it's not my program. Although it's part of the domestic, overall program to expand nuclear power.

I've talked about developing, demonstrating and deploying advanced technologies. Develop and demonstrate advanced reactors that will eventually consume the transuranics. And then a nuclear, fuel, recycling center and advanced reactor and a research facility.

Next slide. Here you see the three facilities. I won't go into them. Suffice it to say the spent fuel separations is your reprocessing component. The fast reactor to burn the transuranics. And this would be a DOE led, DOE laboratory led, research and development facility that would support then the GNEP facilities and the closing of that fuel cycle.

Next slide. So what are we doing in the near term. The near-term activities are involved around gaining US and international industries and governments to get them on board, to get them to participate, to bring the resources that they have to bear. We are right now engaging industry in conceptual design studies and engineering studies to help us better understand what would be involved in a reprocessing regime or recycle regime.

People talk a lot about the technology in GNEP. There are a lot of varying opinions about where that technology is and how that technology is being handled or being developed. Pieces of it certainly are in place. Some of the more complete separations where you would group extract the transuranics from the spent fuel does need a little work. And we continue to develop that.

And then we're preparing a programmatic, environmental, impact statement with a record of decision due in the summer.

So right now this is, I won't go into this. This is what we have right now. We've got the open fuel cycle, a once-through or enriched it's put in the light-water reactors. It goes out and presumably would go into Yucca.

The next slide. The once-through fuel cycle we feel limits us to deep, geological disposal for all of the intact fuel. Included in that fuel as we heard earlier, neptunium, plutonium, americium and curium. Their decay products are key drivers for the dose that one could estimate or project at Yucca Mountain.

GNEP obviously the group extraction of the transuranics is what we're talking about here. It's designed to remove those elements from the waste stream that would then eventually for into Yucca Mountain.

So this is the closed fuel cycle. These essentially are the GNEP facilities. That would still be Yucca. The separations plant would feed the fuel fabrication which would go into the fast reactors where the transuranics would be destroyed. And then that would loop around, and it's fair to say a number of times, this isn't once out of the light-water reactor, once through the cycle and then into the repository.

Okay, next slide. What the closed-fuel cycle approach does allow us to do is separate the waste products from the useable products that are left in the spent nuclear fuel. The separated wastes, we feel, are easier to manage, i.e. we're not going to have this discussion over a million year standard or a 100,000 year standard or a

10,000 year standard.

The cesium and strontium are removed for separate decay storage above surface. The plutonium, americium and curium, and that should say neptunium in there as well, are recycled through the fast reactors.

There was a comment this morning about the purity of the uranium. This uranium is like six/ninths pure which we've demonstrated in laboratory scale consistently could be re-enriched for use in light-water reactors or for the reactor fuel that you would put into a fast reactor. You'll need uranium for that fuel as well. So this would also be a good source of uranium for that.

Eric Knox had it on his slide this morning, reducing the volume, enhancing the thermal management capabilities of what you're placing in Yucca Mountain. And one point that you'll see in anything the Department talks about is, in this particular instance the Office of Nuclear Energy and the Office of Civilian Radioactive Waste Management are in lock step.

Yucca Mountain is needed regardless of the fuel cycle that we would pursue as a nation.

And GNEP only makes, we think, a Yucca Mountain solution much easier.

Okay. So we put this diagram together, this pictorial, to try and demonstrate many of the things you heard this morning. So this is a spent-fuel assembly. And if you went through a GNEP-type process or a reprocessing type situation you would be able to recycle all of these elements as fuel.

And then for decay storage or permanent storage with a significantly reduced radiological hazard. That's the material that could go in Yucca Mountain. There's the cesium and strontium we would let decay a number of half-lives on the surface. And then you could dispose of it as low-level waste.

The technetium and the transuranic losses, the other structural components of the spent nuclear fuel and the fission products would still very likely be destined for Yucca. That's the piece where we need Yucca regardless.

Next slide. So where are we going from here? We have been very diligent in bringing on international partnership, international partners to help us move GNEP forward. We like to call that the G and the P of GNEP, the Global Partnership.

We are now actively engaging industry. Industry was not, when GNEP was rolled out industry had not been actively engaged in the, in establishing the path forward for GNEP. It was done primarily inside of DOE and with our national laboratories.

And industry is bringing a lot to this game. Last summer we received 18 expressions of interest from industry to provide their expressions of what they would have GNEP look like or how they could possibly get involved. And those have been very informative.

We are going to continue to get foremost national and international experts involved. A lot of the expertise is international. The Japanese, the French, the Russians working very diligently to advance the research and development within our laboratories, within the international community, within industry.

And the bottom line is we want to put in place a cornerstone that will anchor nuclear power, a vibrant, domestic, nuclear, electric generation capacity within the United States and address the potential with this large expansion of nuclear power worldwide to help address the nuclear proliferation piece. And I am done.

PRESIDING MEMBER PFANNENSTIEL: Thank you. I have a question about the role of industry. And it sounds like you're just now bringing them into the discussion.

What about in other countries that are party to this. Have they engaged industry in their countries?

MR. FRAZIER: Yes they have. In fact the, in France for example, AREVA is essentially a government type of organization. They are supported very well by the French government.

It's the same way in Japan. There is a real, the Japanese have a very strong government industry partnership, much like AREVA does with France.

Russia is a separate kind of animal. But once again, now, their government there is very eager to participate with us on the advanced fuel development, the advanced recycling as well as the fuel bank which is this whole supplier, fuel suppliers and fuel users with the take back and the reprocessing.

PRESIDING MEMBER PFANNENSTIEL: So it's in the United States that industry is the farthest outside this?

MR. FRAZIER: I think that's fair to say at this point. But it's also, Assistant Secretary Spurgeon has made it very clear that we're going to move ourselves towards very close collaboration between the government and industry to help pull all of this together to make it work within the United States.

PRESIDING MEMBER PFANNENSTIEL: Thank you.

MR. FRAZIER: Sure.

COMMISSIONER BOYD: May I, Mr. Frazier I didn't see anything that looked like a schedule in your presentation. Can you give us a sense of the timeframe of when all of this is to take place.

MR. FRAZIER: I can give you general timeframes. We are anticipating the 2020, 2025 timeframe to have a fairly substantial scale reprocessing capability established.

The fast reactors may or may not be in that timeframe. We're still waiting to reap what we have received recently from industry and trying to determine what the best path forward there may be.

COMMISSIONER BOYD: There were three 20s in a row there, 20, 20, 25. So about on the order of 15, 20 years from now.

MR. FRAZIER: Correct.

COMMISSIONER BOYD: Okay. Thank you.

MR. FRAZIER: Sure.

ASSOCIATE MEMBER GEESMAN: Have you had an opportunity to look at the Keystone consensus industry academia document that was published earlier this month?

MR. FRAZIER: I have not sir.

ASSOCIATE MEMBER GEESMAN: Okay. Are you familiar with the Keystone organization?

MR. FRAZIER: No. Maybe it was on my list to read.

ASSOCIATE MEMBER GEESMAN: In general what sort of weight to you think a body such as ours should place on that type of consensus document in expressing broad, general themes.

MR. FRAZIER: And I will, Alan this morning really said it well about consensus documents. Having been the point person on establishing consensus documents before, that's really the way you get those kinds of things done.

But I would offer that you should consider it carefully. There are some good thoughts from what I understand reading just the executive summary. I certainly wouldn't discount it. The Department is going to read it and consider it just as everyone should.

ASSOCIATE MEMBER GEESMAN: They have areas where they were in agreement with GNEP and a couple of areas where they were opposed or in disagreement.

One of the latter, they indicated that they believed that critical elements of GNEP are unlikely to succeed because GNEP requires the deployment of commercial scale reprocessing plants and a large fraction of the US and global commercial reactor fleets would have to be fast reactors. Do you agree that the faster reactor component is a necessary element of GNEP?

MR. FRAZIER: Well let me go back to the basic, fast reactors have to be a component of GNEP. Let me say that. Now the timing is relative let's say.

Ultimately you're going to have to have a fast reactor to destroy the transuranics, the neptunium, the plutonium, the curium, the americium in enough quantity to realize the benefits to a Yucca Mountain or any other geological repository where you have these long-lived radionuclides that you need to destroy.

Fortunately there's a lot of energy left in those same nuclides. But in order to do that efficiently, and you can do some of it in light-water reactors. The problem with light-water reactors is you continue to generate more of that which you're destroying.

But eventually fast reactors are going to be necessary.

ASSOCIATE MEMBER GEESMAN: They don't need to be contemporaneously available, do they?

MR. FRAZIER: No I think one could theorize a scenario that would allow you to store the separated transuranics, which by the way, we don't view as a waste. We view those as a resource.

So you would store this resource until your fast reactor fleet or x number were up and running and enable to efficiently use that material.

ASSOCIATE MEMBER GEESMAN: Well I suspect Bin Ladin regards it as a resource as well but leaving that aside, conceptually then we could wait 100 or 200 years for the fast reactors, couldn't we? We have confidence in our ability to store transuranics?

MR. FRAZIER: I wouldn't care to wait that long. One could theorize that, the fast reactor technology by the way, is pretty well proven globally. It's not a far stretch to get where we're wanting to go with fast reactors.

There's been a lot of discussion about the research and development required to support, primarily it's been in the fuel side. The transmutation fuel which is what we call the fuel with the plutonium, neptunium, americium and curium is not necessarily easy to make. You have to make it in a hot cell. You can't make it in a glove box because of the radiation levels.

That to us, at least, is the long pole in the tent as far as fast reactors go.

ASSOCIATE MEMBER GEESMAN: Well now you mentioned to Commissioner Byron 15 to 20 years from the logical underpinning of GNEP. What do you think the outer range of acceptability would be in terms of the availability of fast reactors?

MR. FRAZIER: Well this is purely a

guess, probably 2035.

ASSOCIATE MEMBER GEESMAN: Okay.

MR. FRAZIER: I mean if we could do something in the intermediate time to realize some benefits.

ASSOCIATE MEMBER GEESMAN: Thanks very much.

MR. FRAZIER: Sure.

COMMISSIONER BOYD: Therein lies the rub or therein lies the crux of a dilemma we've been facing in the nuclear arena for a long, long time. The prognosis of when technology is going to arrive. So some of us are open minded but a little skeptical about our ability to project when some of this technology will arrive on the scene.

In the early 1960s I was working on the state water project and we were going to have a breeder reactor to help us generate power here in California to address the energy deficiency of that facility. And I even had the privilege of meeting Admiral Rickover in that dialogue.

However, I guess we're all still waiting. I'm open minded and I hope to learn --

MR. FRAZIER: Glad to learn the admiral is.

COMMISSIONER BOYD: -- I think he gave up the ghost so to speak. In any event I look to hear more in these two days about technology but I tend to get a little skeptical.

PRESIDING MEMBER PFANNENSTIEL: Other questions? Thank you very much for coming and sharing this with us.

MR. FRAZIER: Thank you.

PRESIDING MEMBER PFANNENSTIEL: Steve I think our next speaker will be introduced by Commissioner Rosenfeld.

COMMISSIONER ROSENFELD: Good afternoon. Our next speaker is Dick Garwin. I can't resist taking a minute to introduce him. I also looked for his biography in the binder and didn't find it so I'm partly in order. And he has it up on the screen.

I've known Dick since we met at the University of Chicago as Fermi's graduate students in about 1947 and have been wowed by him ever since.

He has been a professor at Columbia, a professor at Harvard, IBM Senior Fellow, member of the president's Science Advisory Committee under at least three presidents. I think he got started under Eisenhower. Received the Enrico Fermi Award for a long-time success in both particle physics and public interest, public goods testimony.

Most people are pretty proud if they get to be members of the National Academy of Science or Engineering or Medicine. Dick is a member of all three.

I noticed that he is a member of the Defense Science Board, was Chairman of the State Department Board on Controlling Atomic Energy and Non-proliferation. He has the Highest Intelligence Community Award, the R. B. Jones Award.

Nearly 500 papers, 45 patents and numerous books. And I don't think any major issue in Congress goes by in technology that Dick isn't there to testify. And we're honored to have him today. So, my good friend, my awe-inspiring friend, Dick Garwin.

DR. GARWIN: Thanks Art. Thanks for the opportunity. Let's see if I can make this work as I want.

So I'm going to try and answer the questions that the Commission posed. And I've highlighted some of my words here. My presentation will be posted as it is not only at the Commission's website but also at my own highlighted here in yellow.

Now the Commission asked a demonstrated technology for disposal or reprocessing this spent nuclear fuel does not exist, couldn't approve a license application under the law. And I think that's actually a slight confusion there. Indeed you can't approve a license application under the law. But you couldn't approve one even if reprocessing of nuclear fuel existed because the law says that in any case the permanent disposal has to be available, demonstrated, approved and operational.

And I think that everybody here agrees that physically ultimately you need a repository. In reprocessing the French Atomic Energy Commission which has a lot of involvement in this, over the many years has argued that the volume of nuclear waste is reduced by a factor two, four or more by reprocessing. And implied, and in fact stated, that the repository could be smaller, less demand for a repository as a result.

Not so. If you read current US government documents from the Argonne Laboratory from Idaho Engineering Laboratory you find that reprocessing and recycle as practiced in France or will be practiced in Japan has a negligible impact on repository needs because it is the heat from the spent fuel and not the volume that makes the difference.

So I certainly concur that a repository is necessary. But I believe that Yucca Mountain will be adequate for 100 years without reprocessing. And that the law should be changed so that demonstration and practice of dry cask storage with high confidence of 100-year longevity should be adequate to permit the deployment of additional nuclear reactors in California.

Not to take the pressure of getting a repository or more repositories but we don't need to have it before we build more reactors including in California.

A French Government report of year 2000 indicates that direct disposal would have cost $41 billion for the French nuclear fuel whereas limited recycle and disposal actually practiced will cost $74 billion, $84 billion without a $10 billion credit for reduced uranium usage.

Now California needs a comprehensive

assessment of implications of indefinitely relying on at-reactor, spent, fuel storage. And there should be centralized interim fuel storage proposals.

I don't agree that there should be mandatory, centralized, fuel storage. But I think that when firms and localities can make money out of suitably, regulated, dry, cask storage there will be both an incentive on the commercial side and a guarantee of quality through the regulation.

That's what they are finding in Sweden. That you don't force a repository on people, you ask for those who are willing to host it.

The French have found that too but they have no takers because they've not been particularly honest about it.

Now what is the current program strategy and timeline for GNEP? It gets me (laughter). Try as I have I've been unable to discern a program strategy or timeline for GNEP. I've tried to get the government make a technical website where they post the current status of papers that support GNEP. They are incompetent. They say they cannot do that because their website for GNEP which is closed to the public is run by Sandia which is a contractor and they have no way of influencing the contractor. They ought to get another contractor. We can't get another DOE but they should get another contractor.

The portions of GNEP I thoroughly support are the secure fuel cycle. But we're spending no money on the secure fuel cycle. We're requesting $405 million next year, $10 million for one-fortieth of it for safeguards research. But how much money are we putting in to having an international, not just US, international facility and agreements for supplying low-enriched fuel and an international framework so that people can take away, not just take back, but take away for disposition, doesn't matter to the reactor operator whether the material is reprocessed before disposal or whether there put into mined, geologic repositories.

We haven't decided whether we're going to supply LEU fuel elements, bundles, for the various kinds of reactors or ceramic pellets and let people do it themselves.

As for the vision of eliminating the minor actinides or transuranics, the TRU, by the deployment of low-conversion burner reactors there's a lot of confusion here. GNEP says they'll have advanced burner reactors that can burn up these fissionable TRU and produce only .25 plutonium nucleus for each TRU burned.

But in a 1996 exhaustive report paid for by DOE General Electric says that they could not imagine a burner reactor, fast reactor with a conversion ratio less than .65. If you have a conversion ratio of one you've done nothing. You put in TRU you get out plutonium and .65 means that you need about three times as many burner reactors.

That's a big swinger is to understand what that is. So that seems to have fallen by the wayside in the commercially, oriented approach to which GNEP has expanded with the purpose of reprocessing spent fuel.

Now apparently the National Security Council has stated that no reprocessing approach that yields separated plutonium or even plutonium mixed with uranium as in the COEX process would satisfy the goal of proliferation resistant reprocessing but that does seem to be what some the competitors are offering.

That's what Cogema does in France with

no uranium in the product. That's what Japan will be doing at Rokkasho in the future with perhaps an equal amount of uranium and plutonium. But as you will see that doesn't solve the proliferation problem at all. And it legitimates the deployment of such reprocessing throughout the rest of the world because of the title of proliferation resistant.

So the claimed benefits of GNEP are reduction of proliferation potential and a vast expansion of the capacity of Yucca Mountain. But let's look at that.

Even if the advanced burner reactors were deployed and worked perfectly this latter benefit is largely illusory inasmuch as it involves keeping the most radioactive fission products above ground they say for 300 years or more presumably in the form of passively, cooled, dry, cask storage.

And that dry, cask storage is little different from the dry, cask storage for the spent nuclear fuel itself because the content of the cask is limited by the heat output as well.

You really wouldn't want to store the strontium and cesium the way they do at

Sellafield, above ground in triply-redundant, force-cooled, high-activity, liquid volumes.

I testified this as a mistake in 2006. I emphasized on the basis of the Argonne National Laboratory analysis that it's not the volume of the waste but the heat load that determines repository capacity.

Even if the transition to a breeder reactor could be done safely and economically, and I advocate that, but only after the research is done, and you can lay out a budget and a time scale. It could limit the repository demand for the disposition of long-life fission products, and addition, the space required for disposition of the spent fuel remaining in the system when fission power is replaced by fusion and when renewable energy has become cheaper than fission energy. It's unlikely that reactors will continue to operate for hundreds of years simply to get rid of the vast residues of these transuranics.

It seems likely that the entire inventory will have to be voided into the repository corresponding to four to six years of output of spent fuel in the expanded nuclear economy even in the non-reprocessing approach.

Well GNEP is in a state of flux. GNEP has changed a lot since the announcement in February of 2006 with the introduction of the commercial side which is going to do reprocessing but not fast reactors. I noticed on one of the slides shown by Tim Frazier that on the left hand side there are sodium reactors to be deployed. On the right hand side advanced burner reactors of some kind.

Well there is no plutonium-burning, large, power reactor in the world right now. There have been many attempts. There was the Fermi reactor, no relationship to Enrico Fermi. There was the Super Phoenix in France, a big reactor that was dis-established and removed a few years ago. There is a reactor, the BN-600 in Russia but it burns high-enriched uranium rather than plutonium. Although it could be used and a BN-800 could be used for plutonium disposition.

Now what about the repository. Yucca Mountain could be used. Will there be a reduction in priority for Yucca Mountain. Well DOE says, no. But it will inevitably have reduced priority because it will reduce the perceived need. In fact we ought to all agree that we absolutely need a repository. But we don't need one now or yesterday. We could have one 100 years from now and it could then be Yucca Mountain in competition with other things.

The Electric Power Research Institute and the Idaho Nuclear Laboratory in 2006 opined, in addition reprocessing plants are expensive and not attractive to commercial financing in the context of the US economy. So when we say that there is no schedule in GNEP there's also no budget in GNEP. There's no indication of what the required subsidy by the federal government and the people who use nuclear power will have to be.

EPRI-INL say projections of major savings in Yucca Mountain as a result of reprocessing are highly speculative at best. And then another report goes on to say, EPRI is confident that at least four times the legislative limit, so 260,000 metric tons of uranium can be emplaced in the Yucca Mountain system and maybe twice that or more.

So a single, expanded, capacity, spent-fuel repository at Yucca Mountain is adequate, in their opinion, to meet US needs. Now I say that if in addition the United States gave up its commitment only to dry repositories and, Yucca Mountain is not really dry, there would be vast potential capacity, for instance in mined, geologic, repositories, that are frankly, wet, saline and below sea level. Rather like the Swedish repository.

But one Yucca Mountain would then have to compete and probably other folks would offer storage, regulated storage for less.

The cost of recycle I indicated the numbers in France is high. And if it's attributed to the reduction in the natural uranium demand, about 20 percent at best, is equivalent to uranium at some 750 to $1,000 per kilogram of natural uranium. In comparison with the recent 35 to 80 kilograms I took the same numbers that AREVA had taken. And even a temporary surge that you see now above that level.

What we really need and what the Department of Energy could do and is not doing is to pin down the cost of uranium as a function of millions of tons of uranium acquired instead of the three to four million of assured reserve, how much would it cost per ton per kilogram, maybe

$200 per kilogram, do I have a 100 million tons of terrestrial uranium. And how much for the 4,000 million tons of uranium in sea water?

Well reprocessing is not without hazard. Cogema at La Hague in France handles some 1600 metric tons of initial heavy metal, uranium per year without apparent problems but Thorp has been shut down for more than two years. They discovered a months long leak of a reactors years worth of dissolved spent fuel.

And if you assume that the customers were paying $1,000 per kilogram that's $1.5 billion of income lost. And if we had a single plant with a single point failure like that the whole system would grind to a halt.

So there are many potential problems with reprocessing and minimal benefits for reprocessing LWR fuel. As Tim Frazier indicated reprocessing is mandatory for breeder reactors or the advanced burner reactors. But breeders would be desirable on balance if cheaper, safer, and less proliferation prone than LWRs, light-water reactors taking into account the hazards of reprocessing.

We've practiced reprocessing at West

Valley, New York. Six hundred tons of spent fuel were reprocessed with a clean-up cost for the site of $2.5 billion for an expected $4,000 per kilogram of spent fuel compared with about a $1,000 per kilogram for disposition into a mined, geologic repository when we get one.

BNFL the Thorp plant was transferred within days of discovery of the leak in April 2005 to the Nuclear Decommissioning Authority. So the taxpayers will be responsible for an estimated $75 billion of cleanup costs. No wonder BNFL was making a profit turning over the clean up to the public.

We have now very good papers by Phillip Finck who's a technical person with Argonne and now with Idaho Nuclear Laboratory which demonstrate conclusively that limited recycle as practiced in France and beginning to operate in Japan makes no significant improvement in repository capacity.

Finck is frank in saying that the reprocessing serves as a delay line, adding another 15 to 20 years before fuel can be transferred to the repository. But a better way to delay the final disposition is to store the fuel in dry cask storage.

The most recent reprocessing plant is Rokkasho under hot test in Japan. It costs $20 billion for an annual capacity of about 800 tons per year of spent fuel. And scaling this to the US repository of 2,500 tons per year would yield an investment requirement of the order of $60 billion or something like $8 billion per year annual amortization rate for a reprocessing cost contribution of some $3,000 per kilogram of spent fuel processed.

GNEP envisions the fielding of a fleet of fast reactors that if you had a conversion ratio of .65 would correspond to something like 70 gigawatts of capacity compared with the 100 gigawatts we have now. And that would require an investment of something like $3,000 per kilowatt or something like 200 billion for the investment in fast reactors alone.

So you pay up front. You get back any benefit later. An economic analysis which we have not had a hint of from GNEP has to take that into account on a discounted cash flow basis.

GNEP will have quite the opposite impact than to augment the US and world non-proliferation efforts because its rubric of proliferation resistant reprocessing will then legitimize deployment elsewhere of something that is proliferation prone.

That is, product would be approximately equal amounts of plutonium and uranium. If you wanted to convert that into a nuclear weapon you'd steal 20 kilograms of the plutonium/uranium powder. You reprocess it by simple chemistry on the bench, no penetrating radiation, no radiation shields necessary for a short time reprocessing to make a few bombs.

In contrast you'd have to steal 1,000 kilograms of highly-radioactive, spent fuel in a non-reprocessing system. Furthermore the commitments of France and Britain to return to the country of origin the plutonium and fission product waste, these commitments are falling by the wayside. A recent announcement of the Nuclear Decommissioning Authority and the clean up costs at Sellafield will be borne by the British taxpayer.

Reprocessing in the United States is deservedly controversial and clearly should not go forward in my opinion. The initiation of reprocessing would turn and increasingly, favorable, public consensus toward nuclear power into substantial and deserved opposition.

`And I provide some references. The 1996 National Academy Study funded by the Department of Energy, never referred to in the GNEP literature, Nuclear Waste Technologies for Separation and Transportation can be read online or it would be worth buying if you had to do that.

In 2006 DOE report to Congress on the plan to reprocess fuel from experimental, breeder reactors states that 25 tons will be subject to pyro processing and disposition at a cost of $400 million. That's $16,000 per ton of spent fuel.

And breeder reactors do have a long history but it's mostly unsatisfactory and part due to vexing problems with leaks of molten sodium. Hyman Rickover, Admiral Rickover deployed a fast reactor, sodium-cooled ship and couldn't wait to convert it to a light-water reactor.

Safety analysis and the safety considerations are very different from those for a light-water reactor and need to be conducted in a transparent and modern fashion with enormously, expanded, computational and modeling capacity that is evident in the US Nuclear Weapons Program.

So at the top level the need is confidentially to design and demonstrate before even a prototype is constructed that a candid, breeder reactor will be safer and cheaper than the existing stock of reactors.

There's insufficient effort in addressing these questions. And I've proposed a World Advanced Nuclear Power Laboratory to do this in a cooperative fashion.

But we'll never get there so long as we have unrealistic assessments, so long as we have no transparent, technical papers from the Department of Energy in this regard, so long as we have fantastic time scales, you know if you're going to design a breeder reactor it will take you 10 years to do the research, take you another five years to make a prototype, then you have to make a decision. Was the prototype satisfactory? Take another 10 years to get first of breed deployed and to see how well that works.

And so that would be about the year 2030 if we started right now with a reasonable program. And the world did it in a cooperative fashion instead of imagining that one more sodium-cooled, breeder reactor is now going to be a success contrary to the experience. Thank you.

PRESIDING MEMBER PFANNENSTIEL: Thank you sir. Questions. Commissioner Geesman.

ASSOCIATE MEMBER GEESMAN: Thank you very much for being here. In 2005 we spent quite a bit of time going into dry cask storage both at the reactor and in a central location. And we were told that there would likely be a repackaging requirement somewhere between 30 and 50 years after initially putting wastes in a cask.

Do you agree with that and, if so, how does that impact your thinking about a 100 years of security?

DR. GARWIN: Well, I don't know and certainly Alan Hanson should have been asked that question because his company provides many of the dry casks storage. I don't see why it should be true but it wouldn't matter because it costs money to put the stuff into dry, cask storage but 50 years from now if it would cost the same than the discounted value of something of an expenditure of 50 years hence if you discount at five percent per year which is what makes it biggest would be only about 10 percent of the first cost.

So it wouldn't matter but I see no reason why it should be true.

ASSOCIATE MEMBER GEESMAN: Thank you.

PRESIDING MEMBER PFANNENSTIEL: Other questions? Thank you very much. Steve.

MR. McCLARY: The next panelist we have is Dr. Per Peterson who's a professor and former Chair of the Department of Nuclear Engineering at U. C. Berkeley. He received his Bachelor's in Mechanical Engineering at the University of Nevada and has worked on high-level radioactive waste processing for Bechtel. He's been a National Science Foundation Presidential Young Investigator. He is past chairman of the Thermal Hydraulics Division and a Fellow of the American Nuclear Society.

He's done a lot of work for industry and in academia on thermal transfer questions, on materials, on nuclear reprocessing issues, applications in energy in environmental systems.

He is also affiliated with the Energy Resources Group at Berkeley. And he's on the Diablo Canyon Independent Safety Commission at the appointment of the California Attorney General.

Dr. Peterson.

DR. PETERSON: Thanks. Could you help me get my presentation.

MR. McCLARY: Yeah, sure.

DR. PETERSON: It disappeared on us here. While these are coming up I'd like to thank the Commission for this opportunity to speak today on the topic of nuclear energy and I'll be discussing some issues that relate to the future role of reprocessing both in the near term and the longer term.

I'd like to also provide a somewhat, broader context. In some of the discussion today, of course, we're thinking about the role of nuclear energy but it's in the context of a larger set of issues that we face. And so, for example, if we're interested in the question of the safety and security of transportation of nuclear wastes, that really needs to be viewed in the larger context of all of the transportation that we do including hazardous chemicals and whether or not it increased the risk associated with that.

The same goes for waste disposal. And so it's quite important to make comparisons and actually look systematically at how what we plan to do for nuclear wastes compares to what we do for chemical wastes.

And then finally the really big issue, of course, is climate change and the role of different sources of energy there. And so let me just go ahead and give a brief overview. I think it is important for us to put this discussion in the context of the potential future growth of nuclear energy use particularly for reprocessing because it doesn't make sense to enter into reprocessing unless you envision some sustained use of fission. So we can discuss that.

One of the motivations for reprocessing is uranium supply and cost. And I'll discuss that briefly.

Reduction of the nuclear waste burden including life-cycle, environmental impacts and avoiding a potential need for multiple repositories.

I'll speak some to nuclear security both proliferation and physical protection issues. And then conclude with some observations.

So let's look at the potential for future growth of nuclear energy. There is some uncertainty. But one of the things that we can do is to look at the question of how much nuclear energy would we need to make a difference particularly in the context of climate change.

And the best way of thinking of that is to look in terms of stabilization wedges and the figure that you see here is taken from the paper by Pacala and Socolow in Science of 2004.

And it's showing the idea that with roughly seven climate stabilization wedges we would have the potential to stabilize emissions of carbon dioxide.

And pictured here is what we would have to do for nuclear energy to play a role of providing one of those climate stabilization wedges.

And basically what we would need is within the next 25 years to build approximately 100 gigawatts of new capacity. And then another 200 gigawatts of new construction between 2030 and 2050 both to continue the growth of that wedge and also to compensate for decommissioning of existing reactors.

Now it turns out that this rate of growth that's required over the next 20 years or so is quite comparable to what we did over about a 20 year period from 1970 to 1990. The only difference is that actually we'd be doing it in the context of a much larger economy.

And so from the perspective of the technology and economics it may not be as challenging as it was the first time through.

This graph provides a little bit more quantitative view. You can see again that over the next 20 years to provide a climate stabilization wedge we'd need to add about a 100 gigawatts.

One of the things that we should be thinking about in this context is it's not completely clear that when we get to 2030 we continue and build more reactors. I mean future generations will make that decision.

So we should really be thinking here about the question of would we need reprocessing if we were to build say another 100 gigawatts of new capacity over the next 20 years and put us on the trajectory of having a full, stabilization wedge.

And if we did that would it make sense perhaps, and when would it make sense to introduce recycle. And certainly if we stay on the route to a stabilization wedge we're talking about a substantial number of new reactors by 2050 and the potential demand for logic behind recycle would be stronger, certainly, further on out if we stay on this trajectory.

So we should also take a look at where California will sit in this overall situation. And this is a fairly familiar graph of course to the Commission showing our different sources of energy for electricity generation.

And a couple of things to note in particular are our rather strong dependence on natural gas which is actually about 2.3 times the national average.

And so in thinking about what California might do in the future with regards to different sources of electricity the first thing is that we really should commend ourselves for the work that's been done here that's established us as a national role model for energy efficiency and electricity demand management.

We've also committed to eliminating our use of imported coal electricity. But one thing that is fairly clear is that our heavy reliance on natural gas really can't be emulated by the rest of the country. There's just not sufficient supply for everybody to go up to 40 to 50 percent level for electricity generation.

And so for California to become a role model in this area we really must not just replace the coal but actually look for approaches to bring our reliance on natural gas back down in line with national averages. And I think that that's fairly challenging thing to do. But it really is what would be necessary if we want to serve as a role model.

So in thinking about what role nuclear plants might play one of the things that we can do is to look at the differences between the current technologies and what we have the potential to build in the future.

And in particular this is a couple of pictures of new reactor designs. One of them is the AP-1000 offered by Westinghouse. The other is the ESBWR offered by General Electric. And we also have EPR from AREVA and APWR coming out from Mitsubishi.

We expect to see actually in this coming year the first new plant orders placed. And we've had a fair amount of discussion about the potential economics of new nuclear plants.

One of the things that we can be doing then is to go ahead and look at these orders when they're placed and find out what the actual bids are. And this information should be valuable because of the fact that these bids will be based on quotes from subcontractors and will perhaps be firmer numbers than what we've seen before.

Now in terms of what the cost might be of California were to build new nuclear plants or if we were to build new plants out of state and import electricity into California. These numbers will be useful but we'd have to recognize that they'll be first-of-a-kind numbers and they're still going to be continued uncertainty just as there is for all different energy sources.

Now another thing to note about these plants that I'd like to point out is that feature enhanced safety compared to our existing plants. I think on Thursday I'll be quoted with a statement that I made that provides an analogy between new nuclear plants and automobile technology. And in particular the fact that these plants with the enhance safety features that they have you can really view this as being equivalent to having added airbags in terms of the level of safety that's achieved.

Now this shouldn't be interpreted as saying that the old plants that only have seatbelts and shoulder harnesses are not sufficiently safe. They aren't as safe. But on the other hand the question of whether or not we should not use those plants is really one of choosing between shutting down coal plants first or shutting down nuclear plants first.

And coal plants are sort of like motorcycles (laughter) if you ask me. In fact coal plants without carbon sequestration are kind of like motorcycles and no helmet. So this is one of the reasons why I think it's important for us to focus on what we can do to develop and deploy new technologies.

So fuel availability. Let me just start by saying that uranium is actually ubiquitous in our environment. It's average is about 1.8 parts per million in our soil. This is one of the areas where actually Berkeley, California is completely average. We have 1.8 parts per million in our soil, uranium.

The question of whether or not there's going to be enough if we were to build another 100 gigawatts of plants and then stay at that level, I think pretty much the consensus is that there's going to be plenty. And in fact the prices are likely to be fairly reasonable.

If we look at the history of what's happened with prices for other minerals what we've found is the technology actually keeps up with or exceeds the effects of scarcity when it comes to producing metals. Of course there can be price spikes for a variety of reasons.

At least for next 20 years we should anticipate that uranium should be sufficiently abundant for us to build new plants. And this is important because it means that we really don't need to worry too much about the cost of the fuel for these plants.

There's also the potential that uranium could be ubiquitous and cheap out into perpetuity depending on our ability to harvest it from increasing dilute resources and in particular the ocean.

Now let me turn to nuclear wastes since that is one of the most important points. And I need to point out that Dick Garwin did state that the California moratorium or the California state law requires that we have a demonstrated, approved and operational disposal capacity. I think actually the state law is very clear that is does not need to be operational. If I read from the state law it says, nothing in this section requires that facilities for the application of that technology or means be available at the time that the Commission makes its findings.

I think this is a very important point because what it says is that the main question is for the government to have a demonstrated technology. And that means to have got a construction license for a repository.

I don't think that it means that we have to build the repository. And, in fact, I think that there's good reasons why we should not rush to build a repository and fill it with spent fuel.

I think there's good reasons to move promptly to clean up our weapons sites. But the potential for us to recycle in the longer term the spent fuel means that it's probably better for us not to rush and spend the money that's in the nuclear waste fund to put it underground at Yucca Mountain.

Let's go ahead and then look at where we stand with waste disposal. Now we have actually a broad scientific consensus that deep, geologic isolation can provide long-term, safe and reversible disposal for nuclear waste. I think that you heard that this morning.

We also actually have a pretty good scientific understanding of what's happening with climate change as well. And we can understand what the long-term consequences of doing both are.

We need to be thinking about those consequences and making some of the decisions that we really need to make in the near term. And I'll be coming back to that in a moment.

Now we have made some significant progress also on Yucca Mountain. And, of course, the principle behind geologic isolation is to place materials deep underground in locations where things don't change very rapidly. And in the case of Yucca Mountain we're talking about 10 million year old ash that was deposited by large volcanoes that are no longer active in Nevada.

Now just as an aside this is, we're thinking here about the potential to add a climate stabilization wedge. If we were to do it with carbon sequestration and get another wedge, instead of putting a modest amount of material into a few thousand acres underneath Yucca Mountain we'd be discussing putting over a billion tons of carbon dioxide under the ground every year in the United States to get an equivalent wedge.

And think about the industrial scale of what's required to do that. And you begin to understand why it is we face a real challenge to get climate change under control.

So this gets to the question of relative risk and what the EPA requires for different things. It turns out EPA doesn't require any sort of long-term analysis for the disposal of any chemicals past 10,000 years. And most things it's substantially shorter.

We have uniquely stringent standards for the disposal of nuclear waste. And it's illustrated here in the sense what we're talking about with Yucca Mountain is the potential that we could contaminate actually relatively small fraction of the groundwater that's available in the Amargosa Valley some 10,000 to 100,000 years from now.

Now we don't want to do that and it is important for the depository to be designed so that it won't. But we need to put this into context. For example, on the left we see all of the wells that are already contaminated with nitrate, with perchlorate and with naturally occurring arsenic. And when we're balancing questions around climate change and things of that nature against potential consequences from Yucca Mountain we really need to put this into sort of a realistic context. This is not the worst thing in the world.

Now the next thing is that the State of Nevada is dedicated in its desire to protect people in the very long term. But the truth is that that dedication really should be directed at their mining industry because the consequences from Yucca Mountain are far small than what we envision is likely to happen from particular the deep pit, open pit gold mining activities.

So another major question related to nuclear waste is going to be technical capacity of repositories either at Yucca Mountain or elsewhere. This is an estimate of what might be available. As Allison noted this morning, one of the big questions is how much space is there.

Draft EIS for Yucca Mountain identified

4200 acres with characteristics that would be required for repository use. Taking a look at heat load and going through calculations one can come to the conclusion that's roughly where EPRI said is that it's quite likely that we could put 250,000, 260,000 metric tons of spent fuel into that site.

Now let's put this into context because that amount of spent fuel is the energy equivalent of having burned 35 billion tons of coal, okay. That's 35 years of total US coal consumption, mining and burning.

And if you think about it for just a moment the environmental consequences that Yucca Mountain will generate are dwarfed by what would happen if we use coal for the same sort of purpose and what will happen because we will use those quantities of coal over the coming quarter century regardless of what we do with nuclear.

Okay, so where does this put us? Well the capacity at Yucca Mountain is sufficiently large and flexible that we can both dispose of waste from our existing reactors and we can certainly also dispose of waste from at least another 100 gigawatts of new reactors.

We may also want to reprocess that waste. But we don't have to make a decision now because we have options available for direct disposal or for reprocessing.

And in fact because intermediate storage is safe and secure and the fact that no rush exists to send commercial spent fuel to Yucca Mountain it may make sense for us to do something such as was proposed by Domenici and Craig in their legislation which would actually say, don't ship spent fuel there until you figure out in the long term you are going to reprocess it.

And if the Secretary of Energy were responsible for making that decision Congress might continue to fund a reasonable, long-term, advanced, fuel cycle R&D program which would answer the question whether or not it's technically feasible to do this in the timeframe of the next couple of decades.

Okay, nuclear security. I don't want to take up too much time. I co-chair and international experts group for the generation for international forum has membership from the International Atomic Energy Agency and from several different countries.

And we've been looking at questions of how to develop new nuclear energy systems of greater proliferation resistance and enhanced physical protection.

The most important thing in thinking about these questions is to look specifically at what are the actual threats or risks that we're trying to control. And in the case of proliferation and then I'll get to physical security or physical protection there's really three major categories that we look at.

One is the potential that states could divert or produce material in their declared facilities and we want to be able to detect that.

The second is that states might build clandestine facilities, replicating them, using technologies in potentially making use of technologies that they've learned about in their declared facilities.

And then the final risk is that they'll abrogate their NPT commitments and overtly use, misuse declared materials and facilities.

The question of how we manage these risks is really one about the international framework that we develop and support. And an ingredient for that certainly is the safeguards that are applied by the International Atomic Energy Agency to detect the diversion of materials and the things that we've done under the additional protocol to make it easier to identify and find clandestine facilities as well.

One significant ingredient that could further improve this and that's strongly supported by the IAEA would be to establish a new regime for the reliable fuel services. And we don't have to get 100 percent participation.

What we'd like to have is to have most states participate because when that's the case then when you get a state like Iran which is not going to, they stand out like a sore thumb, like a rogue, not as a role model.

And I agree with Dick Garwin that this is an area where we could really generate some substantial security benefits if we could get this to work.

Next we have the question of physical protection. This relates to the risks of theft of nuclear materials or important information such as how to design centrifuges and the potential for radiological sabotage of nuclear facilities and transport.

These are things which are much more specific to the design of the facilities and which are much amenable to improved design to provide additional passive barriers.

And so when we think about GNEP technology, actually it's when you move the handling of materials into hot cells that you end up with significant passive barriers to the theft of those materials. And this is one of the benefits that comes from the full recycle.

On radiological sabotage as we move increasingly to passive safety systems we get the same sorts of benefits. And indeed much of the research both within GNEP and Generation IV is focussed on how it is that we can reduce these types of risks.

So to conclude, well, the first thing I'd like to emphasize is that for both climate change and for geological repositories there's a significantly strong base of science for us to make and form policy decisions.

And, in fact, we know that for both of them we face significant political and technical hurdles to getting to solutions. The key point is that for climate change if we wait a few additional decades to take effective action the consequences almost certainly will be quite negative.

But for geologic repositories we can actually take all the time we want. A few extra decades, several extra decades don't matter.

And so when the Nuclear Waste Policy Act is eventually amended well we're probably going to say that we want to take a longer period of time to make sure that we've really got the right options.

Now in order to provide a nuclear, climate, stabilization wedge we must build about a 100 gigawatts of new capacity by 2030. We're actually pretty much on trajectory to do that if you look at the number of new plant orders or new construction license applications that have been announced.

And I think that we can do that with or without reprocessing and still have the capability to dispose of spent fuel that those plants would make.

So the real challenges and the real need for reprocessing is going to emerge in the longer term if indeed we're successful in developing nuclear technology at the scale where it can make a difference for climate change. And that would be in the period from 2030 to 2050, thank you.

PRESIDING MEMBER PFANNENSTIEL: Questions? Commissioner Geesman.

ASSOCIATE MEMBER GEESMAN: Per thanks for coming today. I want to make certain that I understand the logic of your conclusions and then that the semantic arguments you made at the beginning of your presentation.

I believe that your conclusion is that there's no need to rush the process at Yucca Mountain. If that's, in fact, true then we don't need to put too much weight on your argument in the beginning of your presentation that for purposes of the California law application for a permit is the same as demonstration of a capability.

DR. PETERSON: That's a very good question. I do believe that it's important for us to move forward expeditiously with the license application and review. Because we do need to find out technically whether or not Yucca Mountain site is suitable and whether or not it has the characteristics that are necessary to comply with the EPA standards.

I would say that we don't need to rush to build the repository once we have a construction for it.

The other thing is that a really important issue is the public confidence in whether or not the federal government has the capability to safely dispose of nuclear waste.

And frankly the public does not have that confidence now and with good reason. And so a construction license I would say coupled with a small amount of construction and beginning to clean up our nuclear weapons sites should be sufficient.

Beyond that there really is no technical or economic reason to rush besides this question of confidence because we know that interim storage is safe. We know that radioactive decay continuously reduces the amount of heat load that you have to manage in your repository. And we know that the nuclear waste fund accrues interest. So with those considerations we really shouldn't push this process any faster than it needs to go.

And we should really be focused on the

much bigger challenge, when you take a look at what it takes to stabilize carbon emissions globally that's a really big problem. And if you take nuclear off the table it's going to be even more challenging to get there.

We know scientifically and technically that nuclear waste and geologic isolation is a acceptable solution and an effective solution for the disposal of nuclear waste. And we should not therefore take nuclear off the table even though it takes time to put that solution into place.

ASSOCIATE MEMBER GEESMAN: So in terms of the California law wouldn't we be better advised if we're going to accept your argument that the licensure is the equivalent of demonstration, wouldn't we be better off waiting until the license was actually granted rather than simply waiting until the license was applied for.

DR. PETERSON: Right, my personal position is that our scientific understanding of geologic isolation is sufficiently strong now that we shouldn't even need to wait for the licensure of a repository. And so I would advocate that the legislature overturn the law so that we could move forward immediately. Or that it be overturned by referendum because I don't think that it is in our interests given the challenges we face with climate change to hold up construction of new nuclear plants over the question of whether or not we can ultimately get past the political and technical hurdles of getting a repository built when we know that it's a technically and economically acceptable solution.

ASSOCIATE MEMBER GEESMAN: And your belief is that even at the fairly significant level of expansion of nuclear construction envisioned in the Socolow wedge analysis that that contribution at mid-century to climate change abatement would be significant?

DR. PETERSON: Well I think that everybody, I think that one full wedge is a significant contribution. And as I said if it's a carbon sequestration wedge you're talking about just one wedge over a billion tons per year of carbon pumped into the ground.

Each of these wedges comes with a lot of work. I think everybody agrees that the only one that is easy to get most likely is an efficiency wedge or two. But beyond that they're all very challenging.

And I'm actually frankly not that optimistic that we're going to get there. And that we're going to see carbon emissions come down to the level that's needed to prevent rather large climate change effects. We have to work very hard on those.

ASSOCIATE MEMBER GEESMAN: And on the reprocessing side your projections of likely uranium prices and supply availability, if those prove out what prospect is there realistically for the development of a reprocessing industry?

DR. PETERSON: Well reprocessing in the next couple of decades would be driven primarily by the waste management considerations.

ASSOCIATE MEMBER GEESMAN: Okay, that's enough.

DR. PETERSON: As has been pointed out it's not that much more expensive as a fraction of the total cost of producing electricity to reprocess versus not reprocessing. But I think that that's actually a second order decision compared to one about whether or not we proceed expeditiously to build new nuclear capacity because we can manage waste at least for the next 100 gigawatts or so either way.

And so we have options available and a lot of flexibility. I wouldn't hold off on building new reactors either to wait for reprocessing to be in place or to wait until a geological repository has actually been constructed. I don't think that would be wise.

ASSOCIATE MEMBER GEESMAN: Thank you.

COMMISSIONER BOYD: Per I want to comment on something you said not so much that you said it but because I read it in several of the papers that we were provided in preparation for this hearing.

And that is the is the use of natural gas and the fact that California is 2.3 times above the national average of natural gas use. And you didn't say it this way but I certainly inferred it in some of the papers I read that this is a bad thing and we've got to depress ourselves down to the national average.

I think I would agree with you that the whole nation can't catch up with California but I certainly wouldn't agree with some who might to imply that it was a mistake for California to get this deeply invested in the use of natural gas because there's a long, long history here.

And while we weren't cursed with coal in our state from an air-quality, public, health, protection standpoint we did generate as the population grew we and our baseload was no longer hydro it became thermal combustion and we were using oil.

And for air quality reasons I happen to know the two state agencies, the Air Resources Board and this agency, cooperated decades ago on the idea of getting more natural gas into this state and to use natural gas for those reasons.

And of late for the reason that combined-cycle, natural gas all things considered is pretty bloody clean. We also have a policy about that ought to be the benchmark we use.

So I think for California's sake finding itself, like it or not, in leadership roles quite often, I don't think it's fair to infer that's a bad thing.

And also to infer that that means we have to go to LNG and we'll have to get that LNG from unstable places in the world isn't necessarily true either. If we get more than our fair share of LNG it can be from very friendly countries.

So that's just kind of a statement for the record for those who feel slightly different. You didn't say it that way, I'm not picking on you, but you broached the subject and I just wanted to make the comment.

I think it's just one of our wedges in this state, in the nation-state of California at getting at our public health issues be they air quality or climate change.

DR. PETERSON: Very good, thank you.

PRESIDING MEMBER PFANNENSTIEL: Thank you for being here. I just have a very narrow clarification question.

DR. PETERSON: Sure.

PRESIDING MEMBER PFANNENSTIEL: You talked about the 100 gigawatts of nuclear capacity by 2030. And I believe you commented that that doesn't look unreasonable given that the proposals to date. Were you going just in terms of what's in the trade press or actual dollars raised for nuclear plants? What did that refer to?

DR. PETERSON: Right, so that statement refers to the number of construction license applications that have been announced by utilities. There is of course uncertainty as to how many of those utilities will move forward to get constructions licenses and how many of those plants will be built.

A lot of that is going to depend on whether or not we get action on carbon controls because right now utilities are faced with the very difficult set of financial decisions given uncertainty in terms of whether or not they're going to have to pay for carbon because that's going to influence whether we see the energy information agencies projections of huge expansion of coal-fired capacity by 2030 or something else.

But that totals up to about 40 gigawatts of construction license applications which means that planning for that number of sites and that number of reactors is in place. Those reactors could realistically be built out over a five to ten year period which would have them coming online between 2020, 2025.

And if you were then to continue to get orders at a similar rate you might hit a 100 gigawatts by 2030.

PRESIDING MEMBER PFANNENSTIEL: I see, so that's a projection on your part based on what's on the table today.

DR. PETERSON: And of course it's purely a projection. But there is enough capacity in planning right now at utilities for construction license applications that you're on the correct trajectory.

The question is whether the economics and everything else is going to work out to build that. And we'll learn a lot more even in just the coming year as we see the first new plant orders placed and we find out what the vendors are willing to offer them for in terms of cost.

PRESIDING MEMBER PFANNENSTIEL: You answered well, thank you.

DR. PETERSON: Thanks.

PRESIDING MEMBER PFANNENSTIEL: Further questions? Thanks very much for being here.

MR. McCLARY: One of the challenges or the factors underlying our workshop today is that some of the people that we've asked or would like to have participate as panelists are also committed to join with a conference on the east coast, the Carnegie Conference of non-proliferation is occurring nearly simultaneously with our workshop.

Allison Macfarlane this morning had to

leave because that's where she's going. Our next panelist, and I am hoping our next two panelists are in fact at the Carnegie Conference and are joining by phone. And they have agreed to do so for which we're very appreciative.

The first, and I believe he's on the line but we'll be testing our audio capabilities here, is Dr. Frank von Hippel. Dr. Von Hippel has a long and distinguished career in both physics and the application of science in physics to policy.

He's the recipient of numerous awards, more than I can list but they include, the MacArthur Prize, the Triple A. S. Hilliard Roderick Prize and prizes from the Federation of American Scientists, American Physical Society and the National Academy of Sciences.

He's co-director of the Science and Global Security Program at Princeton University. And at one point or another in his career he's partnered for example in the 1980s as Chairman of the Federation of American Scientists.

He partnered with Yevgeny Elikhov in advising Mikhail Gorbachev on the technical basis for steps to end the nuclear arms race.

He's advised our government as well. And in the mid 90s served as Assistant Director for National Security in the White House Office of Science and Technology Policy.

Now I'm hoping that Dr. Von Hippel is on the line and that he can join us now.

DR. VON HIPPEL: I'm here can you hear me?

MR. McCLARY: I can hear you now.

DR. VON HIPPEL: Okay, I'm on the speaker phone but I can try, if that isn't working I can put up the, I can pick up the headset. Should I try that?

MR. McCLARY: Does that sound all right to the audience? It sounds fine from here.

PRESIDING MEMBER PFANNENSTIEL: This sounds fine.

COMMISSIONER BOYD: We hear you fine, yes.

DR. VON HIPPEL: Okay, thank you very much. I'd like to -- And I understand you have my PowerPoint slides out there.

MR. McCLARY: Yes I do.

DR. VON HIPPEL: Okay, great. I'd just like to offer a couple of comments since I have the advantage of coming a little later. Just a couple of clarifications of things that were said before, before I proceed my own presentation.

One is on the UK's position on nuclear power. There actually has been, the Department of Trade and Industry has put out a report backing the construction of new nuclear power plants in the UK, but on the basis that there would not be reprocessing. The UK is shutting down its reprocessing program. It's faced with a clean up cost of $8 billion per gigawatt of capacity that it's had online as a result of this reprocessing program.

The other clarification I'd like to -- On Per Peterson's talk he was talking about stabilization wedge. And I think, correct me if I'm wrong Per, I think you're talking about the US share of the stabilization wedge being, to be covered by an increase of 200 gigawatts of nuclear power.

DR. PETERSON: Frank, exactly yes, that's correct. The US only.

DR. VON HIPPEL: That's on the presumption that the rest of the world builds about three times that amount of capacity at the same time. So you're talking like 800 gigawatts for the stabilization of the wedge.

DR. PETERSON: Exactly, that's correct. The rest of the world would have to follow in rough proportion to what was assumed. I was just asking, I was addressing the US share.

DR. VON HIPPEL: Okay, thanks.

Okay my talk is based on a report that I've written. It may be available to you but in any case I've given the URL on this first transparency. It was published by the International Panel on Fissile Materials, which I co-chair.

Now I'm going to give my perspective which I've been offering in Congressional staff briefings over the last year on the GNEP reprocessing program.

And I start the second slide, which the driver really has been the fact that the US nuclear utilities want the Department of Energy to start removing the spent fuel from the reactor sites. They say that would help encourage investments at new nuclear power plants if the utilities saw that the nuclear, spent nuclear fuel was going someplace.

And I show here a picture of the output from actually one of the few nuclear power plants in the US which has been shut down.

The Maine Yankee Plant stored in dry casks. And each of these casks would hold about a half of a year's output of say a gigawatt nuclear power plant.

Now the Department of Energy in the next, in the third transparency, the Department of Energy, this is my diagram of what the Department of Energy GNEP proposal is.

What's above the red line across this transparency is what we have now, which is low-enriched uranium fuel going into about 100 water-cooled reactors. And then the spent fuel going into storage in those casks onsite. Increasingly in those casks because the spent fuel pools are filling up.

And the casks cost about $1 million each and that works out for about 2,000 tons of spent fuel that's discharged each year to about $0.2 billion a year. And then they put another $0.1 billion a year required to monitor the central storage, to guard it and so on.

Now what the Department of Energy

proposes then is to take this spent fuel and to -- well and everything else below the line is dashed, it indicates that it doesn't exist but the Department of Energy would propose to build it.

Take it to a reprocessing plant where it would be separated into four streams. One of which the so-called transuranics, plutonium at about 10 percent plus other isotopes, neptunium, americium and curium, which would then go to a fuel fabrication plants and then would fuel depending on the conversion ratio of these sodium-cooled reactors 40 to 75 gigawatts would be required to keep up with the rate of discharge of transuranics in the spent fuel from these 100 light-water reactors.

And it would go around and around in this fission. But of course for all that to happen these things have to exist. And the Department of Energy proposes that the reprocessing plant be built and one demonstration of the sodium-cooled, burner reactor be built.

And the utilities then made clear that since the sodium-cooled reactors would be much more costly per unit of generating capacity than the water-cooled reactors that it would require a subsidy for the difference.

And it's not clear to me that Congress will actually come up with the subsidy. So it's quite possible that this program would not actually go fully forward. If it went as far as building the first phase, which the Department of Energy has been asking Congress for money for, you might end up with basically a reprocessing plant, just one of the 40 to 75 sodium-cooled reactors, and see basically all four streams accumulating of the spent fuel converted to four streams of materials accumulating on this site.

And so in effect what you would have done at great expense, you would have moved it, decentralized the spent fuel storage from -- to a centralized accumulation of separated radioactive waste at about ten times the cost that we're spending on storing the spent fuel onsite.

Now AREVA, which is very influential in the Department of Energy, and as you heard at the beginning of this session has another proposal. The proposal is that the Department of Energy do what France does now.

And again in slide four here, again you have the current US fuel cycle above the line and then below the line then you have again a reprocessing plant which would have to be built and a fabrication plant. But via -- The French approach is to recycle the plutonium in fuel and send it back through the water-cooled reactors. And then storage, send it -- this is the so-called mixed oxide or MOX fuel, would then be sent back to the reprocessing plant. But not reprocessed, stored there. That's what they do in France.

So what you're doing here in this case, you are converting a decentralized storage authority arrangement into a centralized spent MOX fuel storage arrangement. So the MOX fuel contains about 70 percent as much plutonium as was originally in the lower-enriched, in the enriched uranium. And then of course you have the other radioactive wastes also in storage because of these plants.

So once again you have a central, you converted to a decentralized to a centralized radioactive waste storage situation. But in any case the cost is only twice as much as what we're doing today because you don't have to build all those sodium-cooled reactors.

Now the next, this transparency just

shows you why, it gives you an indication of why reprocessing is so much, is so expensive. The picture of the French reprocessing plant covers about a square mile.

According to AREVA it cost $20 billion to build, no overnight capital costs, and $1 billion a year to operate. And again this is much more expensive than of course the interim storage.

Now the problem, the reason why I am concerned about this issue, I work on nuclear weapons policies, nuclear proliferation policies, is I'm concerned that the world already has too much separated plutonium to deal with.

And the idea of the US setting up a plant and separating and then most likely piling up an additional 20 to 30 tons of plutonium a year is exactly the opposite direction of which I and my colleagues are trying to move the world, which is toward a situation of smaller stockpiles of separated plutonium to further both disarmament but also to decrease the chances of nuclear terrorism by using this material.

The situation today is that we have about 500 tons, or about 20 years of the output of the proposed DOE plant, of separated plutonium worldwide. About half of that is the legacy of the Cold War. I'm sorry I'm on slide six, I hope you are too. About half of it, you can see the large inventories in the US and Russia are a legacy of the Cold War.

The red colored bar, about half of the, in the case of the US about half of that material has been declared excess. And the US is, the Department of Energy is projecting that it's going to have to pay about $15 billion to get rid of the 45 tons of plutonium, separated plutonium that's declared excess. Well that would be about three years output of the DOE proposed plant.

The blue bars, which is mainly France and the UK, plutonium superpowers, are accumulation of their, of the plutonium that they've accumulated as a result of their commercial reprocessing program.

The UK has a huge problem. France is recycling, as I mentioned, the plutonium that it separates although it has a lag. The UK has no recycling program and the cost, the $75 billion clean up cost that it's incurred as a result of its reprocessing program does not include disposing of the approximately 100 tons of plutonium that's accumulated. It doesn't have any idea of what to do with it at the moment.

Now why worry about separated plutonium more than plutonium in spent fuel. Dr. Garwin already talked about this but here in slide seven you'll see in picture form the left hand side shows a worker at a French reprocessing plant, this is from a visit that I made there in 1994, with a container with two and a half kilograms of plutonium oxide in it. You have very little penetrating radiation coming out of that. That's why he can work safely year after year doing this job of packaging the plutonium.

When I was there they had accumulated 12,000 cans of this material in a World War II warehouse with a padlock on it. Two or three of these containers could, would allow you to build a Nagasaki-type bomb.

On the right you see the, where we have the plutonium now, the civilian plutonium in the US is diluted by 100 times as much uranium. But more importantly, the fission particles could produce a lethal gamma field around it. Even after 50 years after discharge it could kill you, give you a lethal dose within 20 minutes.

So it's much better protected, so-called self-protected. Now I was just -- The reversal could be that the GNEP is proposing to reverse a 30 year US policy which has been: We don't reprocess. You don't need to either. This has been a very successful policy. It's resulted from, we were promoting reprocessing before 1974 worldwide. But one of the countries that we were, whose reprocessing program we facilitated, India, in 1974 used its first plutonium that it separated for a nuclear explosion and that resulted in us rethinking that policy.

Now, I'll just move on. This policy is successful. This policy has been very successful. Contrary to what the Department of Energy argues that we, that we lost our policy details. The world has been moving towards the French. We have to reassert our leadership. This is the actual situation. That since the US adopted this policy of not to reprocess countries, the US of course abandoned, had to have its own reprocessing program but abandoned it in the '70s.

And countries, about equal amounts of nuclear capacity have abandoned reprocessing.

Essentially all the customers of the French and of the Russians have abandoned reprocessing and the UK. The UK itself is abandoning reprocessing as I mentioned. And we had still a situation where only one country, non-nuclear weapon state, that is Japan, is reprocessing. The same situation that will actually -- in the interim Germany and Belgium had small reprocessing programs and also abandoned them.

And only one country now as far as I know is a customer of one of the reprocessing countries, which is the Netherlands, which has a half of a gigawatt nuclear power plant. So it's a been a tremendously successful program.

Now I'm winding up now. I'm on slide 11. I ask what is the matter with interim on-site dry cask storage? It used to be an embarrassment to the nuclear utilities because the anti-nuclear groups would say that you don't know what to do with the spent fuel. You should shut down your reactors until you figure it out.

In fact they've changed their position now. Now they, now that they -- the reprocessing is being offered as an alternative they actually support on-site dry cask storage. More than 100 of the anti-nuclear groups throughout the country.

Now objectively I think that's correct. As an operating nuclear power plant the accident or terrorism risk from dry cask storage is in order of magnitude less than from the fuel in the reactors or the storage pools.

And there's no problem about space. US nuclear power plants have plenty of space within the secured zones. And all the US nuclear power plants could accommodate spent fuel from 15 years of operations and probably more.

But I would characterize GNEP as a panic solution to this problem that the utilities have been complaining about and there's no reason to panic.

So on slide 12 my conclusion is that reprocessing exchanges interim, on-site storage of self-protecting spent fuel for interim stockpiling of material which is easily transportable and from which plutonium could be easily be separated, if it is not already separated.

It would cost two times, the French-style, to ten times the DOE style, more than on-site storage. And the US abandoning its anti-reprocessing policy would provide cover for other countries to develop nuclear -- the US says well now we have an essential part of having a nuclear energy program we would like to do it too. And of course, well too bad we (inaudible).

Now I did add after my conclusion one last slide, which is the high stakes of the GNEP program on Capitol Hill. Congress is becoming skeptical. And I have some quotes here from the report of the committee of the House and the Senate Energy and Water Appropriations -- the Senate Energy and Water Appropriations Subcommittee hasn't acted yet but the House, the House Subcommittee has.

And you have different quotes, very critical of the Department of Energy proposal. And they are not agreeing to fund it. They say it's at best premature. That the committee has not been convinced by the Department of Energy.

And that this could be embarking on a costly, on a costly process leading to major new construction projects is unwise, particularly where there is no urgency.

And before the Department can expect the Committee to support funding for a major new initiative, it has to provide a complete and credible estimate of the life-cycle costs of the program, which has not been done. Thank you.

PRESIDING MEMBER PFANNENSTIEL: Thank you. Are there questions on the dais? No.

Thank you very much for joining us and participating. I understand that it's a difficult thing to do and we really appreciate your making an effort to join this discussion.

DR. VON HIPPEL: My pleasure, thank you.

PRESIDING MEMBER PFANNENSTIEL: Steve where do we go now?

MR. McCLARY: I am not 100 percent certain. We had also asked if he was available, Dr. Charles Ferguson of the Council on Foreign Relations to join us, but I'm not sure whether he's been able to sign in.

DR. FERGUSON: Can you hear me, Steve?

MR. McCLARY: Yes I can.

DR. FERGUSON: Okay I've been listening for an hour and 42 minutes, an hour and 43 minutes according to my clock (laughter). Ever since Tim Frazier's presentation. It's been a very fascinating set of presentations. And I know you're probably at the tail end of your agenda and you're going to segue into your public comment period but if you just give me a few minutes I can try to play clean up here.

MR. McCLARY: Thank you, that would be perfect.

DR. FERGUSON: Great. So I find myself actually nodding in agreement to a lot of what Professor Peterson was saying. But picking up where Dr. Von Hippel made a comment about Per's comment about stabilization wedges, and yet Per did correct himself, or at least clarify that he was referring to the US portion of the wedge.

But I think one important point that hasn't not been emphasized is how much of the total wedge the world would have to provide for nuclear filling up the whole wedge.

And in my report, the Council's Special Report I think you have a copy of, I do a simple calculation and show that according to the Pacala and Socolow Study you would need an additional 700 gigawatts of electrical power by 2054.

But by that year most of the current operating nuclear power plants would have to be decommissioned. So you would have to replace the currently operating 440-some reactors or close to that number, and that's about 370 gigawatts. So you add the 700 and the 370, so you get well over 1,000 gigawatts of nuclear power you have to bring online between now and 2054 to create the stabilization wedge across the globe.

So if you're saying you build basically a one gigawatt or a 1,000 megawatt reactor you would basically need 1,000 reactors over that timeframe. And the reactors could be a bigger size as well. Some of the more modern reactors are 1500 megawatt. But just for a ballpark estimate, if we assume 1,000 reactors that you have to build between now and mid-century and figure that you have roughly 500 months between now and mid-century that means that you have to bring a reactor on-line every two weeks.

Now it is conceivable what Per was saying. In the heyday of nuclear building in this country we were coming somewhat close to that rate of construction. But that quick rate of construction led to several problems developing and it led to the nuclear industry having to go back and do a lot of retrofitting as they saw some problems crop up and it required the Nuclear Regulatory Commission to change the licensing requirements and that led eventually to several construction delays, very long delays.

Now it could be that it was an industry that was still in a very immature phase and was climbing a learning curve. And it could be that the nuclear industry is correct that the more modern plants are building up on that past experience and they would be somewhat easier to build.

But what we're seeing now in Finland with the construction of the EPR, the European Pressurized Reactor, it has fallen behind schedule and the costs are going up. It could be because that's the first of its kind reactor and perhaps learning will occur. Positive learning will occur in the future and that reactor will be standardized and it will go down in price.

But based on past experience, what we've seen is these prices have stayed at fairly high levels or they can actually increase depending on the region or the country or the state that's developing the reactor. So it's very regional-dependant.

But I think my overall message in this point is that we're dealing with a global industry. It is one of the most globalized, energy industries in the world and we are faced with only a few companies that can actually make the critical components for these reactors.

Now I'm not saying that will always be the case. That is what we face right now and we'll probably face that for the next several years, maybe for the next decade or so. Market demand, if it increases, would eventually resolve this bottleneck but we're talking about waiting many years for that bottleneck to be fully resolved. So really doubt that we're going to see an increase much above the 100 gigawatts by 2030 that Per Peterson was projecting.

Still, nuclear energy is going to be part of the mix and I support that. But in general I'm agnostic about how much nuclear is going to grow. I think my main message is that we shouldn't pick winners or losers.

We should assess a fee on carbon emissions. We should basically may the polluter pay for putting greenhouse gas emissions into the atmosphere. And we can either do that through a cap and trade system, which I know California is considering, or we can do that through a carbon tax. I am somewhat agnostic on that issue as well.

But whichever method we choose, it would use the market and rules-based market mechanisms to signal the energy sectors what we are trying to favor. We're trying to favor a future energy system in which we rely less on high carbon dioxide emitting fossil fuel sources like coal plants.

And I think natural gas can be an important bridging technology just to weigh in on the natural gas issue. I think there are some security concerns when we talk about liquified natural gas shipments so we have to pay attention to that. We also have to pay attention to our using natural gas from various foreign sources. But I think there are enough foreign sources for the foreseeable future that are not in unstable regions that we could purchase that natural gas from that I think we could perhaps minimize the security concerns from natural gas, at least for the next decade or two.

Let me just quickly look at my notes. I think there are a couple more points I'd like to make. A lot of this has already been covered before.

I'd like to emphasize that Per Peterson and Frank von Hippel, and I think Dick Garwin also said that the waste disposal issue is manageable and I support a dual track approach in which in parallel we are trying to achieve the political and scientific consensus to eventually open up a permanent repository. Probably at Yucca Mountain, perhaps somewhere else. And in parallel to that we ship as much spent nuclear fuel as we can into dry casks and hard facilities. So those would be secure against terrorist attack.

And so I think there's really no waste crisis that confronts us. I think that shouldn't be a barrier to a growth in the nuclear industry. And I think another main theme I have is that there are lots of uncertainties when we think about climate change and how it's going to affect us. And we are stuck right now with a huge amount of inertia built into the system. Inertia in the sense of lots of greenhouse gases that are already in the atmosphere. It's going to take many decades, perhaps centuries, for the gases to go down to levels that we would like.

And I think in addition to trying to develop these low-carbon emission sources as much as possible we also need in tandem to develop mitigation strategies to be able to withstand some of the dire effects that we could see as climate change continues to play out.

And with GNEP. I think GNEP has some merit in some its aspects. I think especially the aspect of fuel assurances to countries that may be considering developing their own uranium enrichment programs. And as Per Peterson points out and I agree with him, Iran is not going to accept that proposal but I think that proposal at least puts to lie the Iranian claim that their nuclear program is entirely peaceful.

But where I'm concerned about GNEP is the concerns that Frank von Hippel and Dick Garwin raised so there's no need for me to reiterate those. But I would recommend is that we try to delink or separate out the various aspects of GNEP and take each aspect on its merits and demerits.

And I think it's wise to continue to research on proliferation resistant reprocessing but there is no need to rush to development. And certainly no need to rush to commercialize it. As Per pointed out, we appear to have plenty of uranium in the coming decades, even with a fairly big expansion with nuclear power.

I'll stop there because I know we're now into your other segment of your schedule. And I want to thank you for allowing me the opportunity to speak for a few minutes about this important topic.

PRESIDING MEMBER PFANNENSTIEL: Dr. Ferguson, thank you very much for joining us. Are there questions? Yes, Commissioner Geesman.

ASSOCIATE MEMBER GEESMAN: Earlier in the afternoon, I'm not certain if you were on the line at the time or not, but in going through some of Mr. Frazier's charts it appeared that only about 40 percent of the waste from US commercial reactors would likely be in dry cask storage in the year 2015. Do you feel it should be national policy to try and accelerate that pace?

DR. FERGUSON: I do but we need to be very careful about how we go about it because we don't want to increase the risk of exposure to nuclear workers. We have to make sure that --

Well for starters, you have to keep that spent nuclear fuel in the wet storage pools for at least five years to allow the radioactive decay heat to go down to a safe enough level that you can then extract that spent nuclear fuel that has been sitting there for five years and put it into a dry storage cask. And I think we also need to think very carefully about how we can minimize the exposure to the workers as they transfer spent nuclear fuel from a pole into a cask and then from that storage cask into a transport cask to Yucca Mountain or some permanent repository.

What I would like to see happen is that we put more emphasis on dual-use casks that can serve not only for storage but also for eventual permanent disposal.

ASSOCIATE MEMBER GEESMAN: And you mentioned both today and obviously in your paper, this is a global industry. I know that from that perspective it is oftentimes not productive to try and divide the world into good guys and bad guys but we all know that is a common American tendency. Would you go into your thoughts a bit as to how a global industry addresses differing safety cultures.

DR. FERGUSON: Yes indeed. And I touch upon that in my paper. And when I say industry has a very important role to play, they need to make sure that wherever nuclear power plants are operated they're going to meet the highest safety standards. And I point to an organization that grew out of the experience of the Chernobyl accident but actually this organization grew out of the Three Mile Island accident in 1979.

When that accident happened the nuclear industry in the United States formed a peer-review organization that goes by the acronym, INPO. Then they, after the Chernobyl accident, they formed WANO, the World Association of Nuclear Operators.

And what WANO does, it does peer reviews of nuclear power plants throughout the world in most countries and then they give a confidential safety report to the utility company in that country so they can make any changes that are necessary. And that is very important. But as a case some would say, the fox guarding the henhouse.

And I think we also need to promote a very rigorous nuclear safety commission throughout the world. I think the Nuclear Regulatory Commission in the United States has done a good job. We can find fault in certain areas but I think on balance it has been an independent regulator.

And we need to make sure if we're pushing too hard on nuclear expansion, not just in the United States but in other countries, as countries begin to rely more and more on nuclear there is going to be pressure on the part of the regulators to keep those nuclear power plants running no matter what.

What I mean by a strong, independent regulator is a regulator that has enough authority to issue an independent order to shut down of a plant that has a safety problem despite the country's desire to continue to run that plant to make electricity.

ASSOCIATE MEMBER GEESMAN: And that would represent quite a change from today's international control regime, would it not?

DR. FERGUSON: I think so. I think we're still a ways from achieving the gold standard of best safety practices.

ASSOCIATE MEMBER GEESMAN: Thank you very much.

PRESIDING MEMBER PFANNENSTIEL: Further questions? Thank you, Dr. Ferguson.

DR. FERGUSON: Thank you very much.

PRESIDING MEMBER PFANNENSTIEL: Unless I

get a sign otherwise, Steve, I think we will now move into the public comment. I have a number of blue cards that people have filled out indicating a desire to provide comments. I will start Neil Brown. Please give your name and affiliation for the record.

MR. BROWN: Neil Brown. I have had about 40 years experience in the safety and licensing of reactors with General Electric and I am now at Lawrence Livermore National Lab. But I am representing as a member of an ACRE group, which you will hear from several of us. Mainly a group of retired engineers in the nuclear business who are advocating clean, responsible energy.

And I just wanted to make an observation that through today's meeting there's little concern being expressed, and I think rightfully so, for safety. Much of the past experience that we have had now since Three Mile Island and Chernobyl has been a very positive experience. Just the presentation before mentioning WANO and INPO.

Even on an international basis the Japanese have strengthened their regulatory efforts and they have shut down plants, many of them, when they had safety concerns. Similarly for France when safety issues are there. Many countries have now followed the US. And I think we should just recognize that these things are now in a very highly experienced safety regime.

On the other hand the people who have concerns about this continue to look at nuclear and focus on a hazard rather than whether something is safe. And I'm making that distinction because the hazard will remain. We know the hazard and we have known it for many, many years. The safety comes when we have now learned to control the hazard. And many, many areas we've done that but I think that in the nuclear business we are far ahead of many other areas. Thank you.

PRESIDING MEMBER PFANNENSTIEL: Thank you, Mr. Brown. Edwin Sayre.

MR. SAYRE: I am Edwin Sayre, also representing an ACRE group. I have had 50 years of experience in power and nuclear technology and building nuclear plants around the world.

What I want to talk about is the true knowledge of used nuclear fuel for shipping, reprocessing and storage because many people really don't quite understand what it is. Used nuclear fuel is an asset, not just a waste, if understood and handled properly.

Most people have no knowledge of it and think that the used fuel is a very dangerous material that should be safely stored away forever. Fear of used fuel has been generated by anti-nuclear organizations and enhanced by the media and accepted by the public who are not aware of the facts.

Nuclear fuel is rock-hard, uranium oxide pellets, about a half-inch in diameter and a quarter inch thick. It is contained in a zirconium alloy tube about ten feet long. The pellets have a melting point of about 3,000 degrees Fahrenheit. The tube has a melting point of about 3,300 degrees Fahrenheit.

It's a very stable material going into the reactor. The uranium is mostly U-238 with about four and a half percent U-235. A metric ton of used fuel with 30,000 megawatt days of service and 40 to 50 years of decay time contains about four kilograms of zirc alloy cladding, 946 kilograms of U-238 and about 20 kilograms of other actinides including your plutonium and the uranium elements from 234 to 236, neptunium, and only about three and a half to four grams of americium and curium. The balance consists of about 30 kilograms of fission products.

Now when the fuel is reprocessed the U-238 and the other actinides are made into new fuel reactors and we heard a lot about that this afternoon and this morning. These actinides all have potential for absorbing neutrons and fissioning and provide more power. They are an asset.

The zirconium contains a little bit of zirconium 93, which is radioactive with low energy but with a long half-life. So you can have two choices. One it could be either used to be returned back as cladding or you have to store it as low-level waste.

Now the balance is the fission products, which have been considered as a fearful material by those who don't understand what it is. Over half of the fission products are just natural elements, they're not even radioactive. And they're valuable commercial materials such as molybdenum, ruthenium, silver, and cerium.

Half of the rest are just natural

elements that are radioactive. In other words, in nature they have radioactive isotopes such as lanthanum, tellurium and iodinium. These are rare earths that also have commercial value.

There are about two and a half kilograms of strontium 90 and cesium 137, which they talked about too, which can be separated and used for remote energy production. They would have to be recycled periodically because they have a short decay life but they can be used, the Russians have used them for years for that.

The leaves us with a remaining three and a half kilograms only of isotopes that had to be used and need to be treated as waste. They have no use, that is. Have of these have short enough half-lives that they can be stored for 200 years and then put back into the environment with no harm to the environment.

The other half have long half-lives that can be put into reactors and transmuted to non-radioactive elements. Some of these are like Iodine 129. So you can convert those either into non-radioactive elements or short half-life elements that can be stored for another 200 years and then put back into the environment with no harm.

Contrary to the analysis of some groups the technology to do this processing and element separation have been available for many decades. I don't know how many have ever been inside of a reprocessing plant like the one at Hanford but I have. They're ancient things. With the technology we have today of robots and computers and so on I think we could use probably one-tenth the personnel to do the job of reprocessing that was done in those days. So to go commercially and to be economical we use the technology that's coming forward and I think we'll have economical plants there.

The basic PUREX process and variations have been used for economic production of foodstuffs and other materials for over 50 years. The electrical/metallurgical process, which nobody has talked about today but can be used also, has been used to produce, in the production of metals such as aluminum for over 30 years.

While I was at Hanford during the early '60s I managed the program to separate technicium from the waste and reduce it to metal for commercial use. You've heard a lot of people talking about putting technicium away forever. Why do that? It's a good, commercial product. It can do the same thing as its sister element iridium can do. It's a very, very expensive sister element and technicium can be produced to do the same thing.

The commercial development of these processes for reprocessing of used fuel has been deferred by political control partly by anti-nuclear pressure, partly because of the fear of proliferation. The reprocessing can be controlled to prevent proliferation.

Now if all the energy used by California for one year, including transportation, electricity and heating, is generated by nuclear fission and reprocessing is done as I talked about before, properly, the amount of waste material to be stored for 200 years is the size of one little M&M candy for every citizen in California. There is no energy source more environmentally friendly than that.

Now another thing I'd like to talk about,you're talking about storage of fuel at Yucca Mountain or anywhere else for a million years. I think it's kind of stupid. I think it's ridiculous. The main thing is we should store that fuel so that it can be easily taken out of storage in the next 100 years. Because I'm sure there are going to be trillion dollar businesses that are developed to use every element that's in that stuff.

How many of you people when you were youngsters realized how much your life was going to depend on pure silicone today? I don't think any of you did.

When I first started -- I'm a retired Naval aviator also. When I first started flying my airplanes were made out of wood and fiber. I never dreamed at that time that I could fly in a jet 500 miles an hour with 200 other people. And we do that because of the evolution of the use of cobalt and nickel and chromium and aluminum and titanium and even lithium is coming into it now.

It's just amazing how much we're going to learn. I think you ought to think about the next hundred years rather than worrying about storing this stuff for a million years. How many of you also realize that we are now treating millions of patients every year by injecting them with radioactive isotopes? Thank you.

PRESIDING MEMBER PFANNENSTIEL: Thank you, Mr. Sayre. John Hutson.

MR. HUTSON: Thank you. My name is John Hutson, I am president and CEO of Fresno Nuclear Energy Group. A lot of distinguished folks and a lot of distinguished colleges and a lot of smart folks here today. I was really glad I heard all this. But maybe I can add a perspective as to why we want to do what we want to do, to build a nuclear power plant in Fresno. A little different than whether or not we should recycle or how many transportation of isotopes or how many protons, neutrons or electrons are in 234, 235 and 238.

Something about Fresno. Seven of the nine metropolitan areas with chronic double-digit unemployment are located in my valley. The Brookings Institute out of Washington has called us Appalachia West. In order to get those kinds of handles you have to have less doctors per thousand and so many other critical economic conditions.

In the State of California it's reported that domestic violence has went down ten percent in the last ten years. In Fresno it's went up by 60 percent. When asked at the local domestic violence center, the Marjorie Mason Center, why that is, they said lack of opportunities. So we have all of this unemployment.

Dr. Scott England at Fresno State says if we can create just 20,000 jobs that pay $30,000 a year, just that many, it will put $885 million in our economy. Building a nuclear power plant in Fresno where we want to do it makes sense to the community and it's why we've gotten so much community support. It's an economic thing to us.

All these folks from Berkeley and Stanford and MIT are going to figure out if this is the right thing to do. And you folks are going to figure out if lifting this moratorium is the right thing to do. Or whether or not we have to put it on the initiative if it's the right thing to do. But economically it's the right thing to do for Fresno. It's the right thing to do for the Central Valley. It's the right thing to do for folks that don't have jobs and folks that are living in poverty conditions.

If we could ever get our unemployment rate below eight percent for five years, the same doctor, Scott England -- And by the way, the federal government says we can't count agricultural workers or government workers on unemployment rolls. If we can get it below eight percent for five years it means a per capita income increase by ten percent by everybody that lives in the Valley.

All that nuclear power plant is going to do is help us save some of our schools, create opportunities and put a better community more on scale with other parts of California and also other parts of the nation. We desperately want to build this plant.

We took a trip to Rauma, Finland and I looked at the repository. I looked at the 1600 megawatt EPR reactor that they're building, Olkiluoto 3, and from there I went to the reprocessing facility in the south of France. I'm totally convinced that it is the best thing for us and Fresno, the best thing for California, the best thing for the Central Valley.

I appreciate being here today. I learned an awful lot and thank you very much.

ASSOCIATE MEMBER GEESMAN: Question?

PRESIDING MEMBER PFANNENSTIEL: Sure.

ASSOCIATE MEMBER GEESMAN: Sir.

MR. HUTSON: Yes sir.

ASSOCIATE MEMBER GEESMAN: I wonder if you've got a breakdown of those 20,000 jobs. Which are construction and which are operational plant?

MR. HUTSON: Of all of those jobs we certainly know how many jobs will be created by the construction of the plant, that's 5,000 construction jobs for four years. But the associated jobs that will be created by putting a nuclear power plant there, there's only about 1200, 800 to 1200 people that would have permanent jobs for the plant.

But the fact that we're being in partnership with the City of Fresno and allowing Proposition 218 to become involved. Proposition 218 says you can't charge more for the electricity if you're a public utility than it costs you to make it there. That we'll be able to reduce rates for the city. Currently we supply city water with about 300 wells, at times 400 gallons a minute, and that's a $500,000 a month electric bill.

With those things gone, encouraging industry, encouraging other activities when we have that abundance of cheap electricity will transfer itself into many of those jobs, not just the ones that work at the nuclear power plant. How many of those can come from the Valley when they must be so educated and trained I'm not sure of, but the construction force certainly can.

ASSOCIATE MEMBER GEESMAN: So it's the economic benefit associated with a lower cost source of electricity that creates the balance of your jobs.

MR. HUTSON: Absolutely.

ASSOCIATE MEMBER GEESMAN: And you mentioned the wells. Is that how you intend to provide the cooling water to the plant?

MR. HUTSON: No sir. Our wastewater treatment facility in Fresno currently puts out 75 million gallons of gray water a day. We have 3,000 acres there that we spread that water out trying to get it to evaporate because the gray water has very limited use for anything else except to try to get it in the ground and recharge our aquifer.

Just a few miles away we have four very large pumps that pump that water deep in the aquifer back into the river to recharge the river as well. But we are now growing at the rate of 3.2 percent there where the rest of the state is growing at 2 percent and we're doing a wastewater expansion.

We don't have enough places to put it. We're going to have to start putting it on -- Isn't it funny, we live in a desert and we can't do anything with the gray water. But that gray water can be effectively used as the plant in Arizona does. They pump their gray water 90 miles to cool their plant. While ours is only three-quarters of a mile away right underneath the grid. And that has been a wastewater treatment facility since 1890. We think that's the best place to put it and the best water to use for it.

ASSOCIATE MEMBER GEESMAN: Thanks for the clarification.

MR. HUTSON: You're welcome.

PRESIDING MEMBER PFANNENSTIEL: Thank you. Jane Turnbull.

MS. TURNBULL: Good afternoon, Commissioners. I am Jane Turnbull from the League of Women Voters. This has been a very interesting day. Thank you for putting on a meeting like this.

One of the things that was particularly troubling this morning was the information that the Department of Energy has not necessarily been forthright in providing the information that is relevant both to Yucca Mountain and also to GNEP. Information overall seems to have been in short supply until this meeting today.

It appears that many of the conclusions that are being developed are more politically based than scientifically based. The League feels very strongly that transparency has to be a part of the process. If the public is going to have confidence in the validity of decisions we have to know the basis of those decisions.

Bob Loux's comments that the NEPA process has been closed was particularly troubling. The League is a strong proponent of transparency of process and recognizes that the Energy Commission has consistently supported open discussion and public participation. So on behalf of the League I ask that the Commission request the Attorney General to bring suit against DOE to make the information in the NEPA process a public process.

PRESIDING MEMBER PFANNENSTIEL: Thank you, Jane. Carl Walter.

MR. BROWN: He went out just for a

minute, he'll be right back.

PRESIDING MEMBER PFANNENSTIEL: Robert Williams.

MR. WILLIAMS: Yes. I promised not to take two bites at the apple so let me begin by handing you the prepared remarks of Frank Brandt, which are an excellent follow-on to the remarks of Mr. Houston (sic) from Fresno.

And I apologize for fumbling with my papers. I thought I had five copies ready to hand to the Commissioners. Yes, here they are. Let me just read as I walk. Electric power --

PRESIDING MEMBER PFANNENSTIEL: Sir.

ASSOCIATE MEMBER GEESMAN: Please don't talk when you're away from the microphone, the transcript doesn't get you.

COMMISSIONER BOYD: Just give them to me, I'll pass them down.

MR. WILLIAMS: Electric power is the life blood of the state.

ASSOCIATE MEMBER GEESMAN: You're going to have to repeat everything you say when you get to the microphone. It's the only way the transcript picks up your remarks and we need the transcript.

MR. WILLIAMS: I understand, sir. So, electric power is indeed the life blood of the state. And the people and the industry in the state expect that it will be reliable and inexpensive. And when the state puts roadblocks against new nuclear power plants, it didn't affect the reliability or cost back in 1976 or '78 because the cost of nuclear and fossil generating parameters were similar at that time.

But we see now a situation where the replacement cost in California would generate a substantial annual savings. I mis-spoke when I got up earlier. The reference is in the 2005 report. So the savings from replacement energy costs from nuclear power plants is going to be even greater than cited on page 167 of that 2005 report.

So in spite of the increasing demand for electric power the state has made it more and more difficult to build both fossil and nuclear plants and we are highly dependant on imported electricity, including electricity from the northwest and hydropower. Unfortunately hydropower goes through periods of scarcity. It is not reliable. And when it collapsed back in

2000 we had all of these issues over manipulation of power plant prices, all that sort of thing.

So I am going to race through this to the end in order I can have time for a couple more remarks.

It would be wonderful if the CEC recommended nuclear energy as the only practical way to meet a substantial magnitude of the growing needs of California for reliable, inexpensive electric power while reducing the use of fossil fuel.

When you look at the fact that the state population will probably double in the next 30 years, to stay right where we are we're going to at least need to double the amount of nuclear. And then we're going to need to double that if we're going to make any additional increment against saving the amount of CO_2.

Now because I have spent my life in this area I'd like to chime in on a few points that the speakers today earlier made. In particular I'd like to associate myself with Per Peterson's remarks and with Alan Hanson's remarks.

But in particular I personally participated in the waste confidence hearing leading, co-leading the American Nuclear Society's submittal in that hearing. And the whole idea was to prove that storage was sufficiently low-cost, sufficiently reliable and sufficiently long-term, like 100 years or more, that you didn't need to shut down nuclear plants and you didn't need to stop the construction of existing ones.

So that is the fundamental point that Per Peterson and others are making when they say, we don't really need to impose a nuclear moratorium because of the lack of waste disposal licensing.

But then I would like to buttress Per's case by pointing out again that the Waste Isolation Pilot Plant has been licensed for heat-generating waste, for contact handled transuranic waste and has been through that process twice. And with committees of the National Academy, the Nuclear Regulatory Commission and the Defense Nuclear Waste Safety Board.

So you re not sticking out your neck at all if you recommend to the Legislature that the issue of waste disposal should not stand in the way of nuclear ordering.

I'd like to make one other point on

uranium prices. I was in electric power research when uranium prices went through the roof. Now this was despite the fact that Canada and Australia have vast reserves of uranium available at $3 a pound. It's just like Saudi Arabia with $3 a barrel oil. These commodities are susceptible to price manipulation.

So right now when you hear the quote of $135 uranium, what some utility is doing is selling a small quantity to another utility so the accountants can use $135 a pound to value an inventory that will dress up their balance sheet. It's just a little bit of razzmatazz. I can say that because I am not beholden to any of them anymore (laughter).

No subsidy is needed for some of these things. It's like me coming in and asking you to pay me $400 more for my car because you mandated that I have a catalytic converter. Some of these things are going to just have to be done.

It's like taking plastic bottles out of the trash that's going to the sanitary landfill. At some point people will mandate that a packaging technology like reprocessing is required because it makes environmental sense and it makes disposal sense. And never mind all this witchcraft about whether or not it's break-even and whether or not PU recycle is incrementally cheaper.

There is one other point that needs to be brought to the attention of the group. To make the numbers easy, fuel these days is burned up to higher burn-ups than was common at the start of the industry. In round numbers there's about one percent plutonium in discharged, spent fuel. So if you have a 2,000 ton per year reprocessing plant it's going to make 20 tons per year of plutonium.

What are you going to do with that 20 tons per year? The answer is very easy. Each one gigawatt breeder reactors requires between four and five tons of plutonium as its first core inventory. That was such a scarce commodity 30 years ago that lots of us spent parts of our life cranking out how many years it would take before there was enough plutonium to start up one, two, three or ten reactors.

We now have enough plutonium around that a reasonable program of breeder reactors, not helter skelter but not one ever ten years, could be built. And it would be a much better way to store the world's plutonium than sitting around in lockers someplace.

I would leave you with a final point. Because these replacement energy costs are manipulated by people like OPEC. We have seen the price of natural gas go from $2 four years ago up to $12 last year, back down to $7.50 today. And we should not be basing our energy generation mix on the break-even cost between natural gas, coal and nuclear. Because they are susceptible to that manipulation.

We should have the guts to step up and say, we need to move from 13 percent of our generation to 26 percent or 30 percent of our generation in nuclear because it's a practical construction schedule and because it will do this carbon wedge thing that Per was talking about. So thank you.

PRESIDING MEMBER PFANNENSTIEL: Thank you, Mr. Williams. Carl Walter.

MR. WALTER: Sorry I had to step out for a little bit. I'm Carl Walter. I'm a retired, nuclear engineer. I used to work at the Lawrence Livermore National Laboratory. I was here a couple of years ago and spoke with you briefly and

I have more of the same to say.

I was surprised when the history was presented today. Back in 1976 the moratorium on reprocessing and waste disposal was placed on new nuclear plant construction California. No mention was made of the fact that Proposition 15 came along just before that. I was a better speaker in those days and I was on the speaking circuit telling people that they've got to vote that down because nuclear energy is good and it's here to stay. And the results of the election were two-to-one against the initiative. Proposition 15 was soundly defeated by California.

Since then many polls have been taken throughout the country and the public favors, the general public favors nuclear power. Okay.

So that being the case, shortly after the proposition was defeated legislation came along which you're familiar with. I think that you're beholden to recommend to the Legislature that those restrictions on nuclear power plant construction in California be repealed.

I can also go into reprocessing in the sense of not the original considered plan for recycling in light-water reactors. The fast reactor is a much better reactor and a much better way to produce power than a light-water reactor. And you can utilize 100 percent of the fuel in a fast reactor whereas you can only use a little bit of it in a light-water reactor.

The GNEP program therefore is one that I support because it heads into the direction that we were maybe 15 years ago when we had the ALMR program going in the United States. We had a fast reactor with fuel recycling, FR/FR I liked to call it. And it requires no further mining of uranium, no enrichment of uranium. Just utilize the spent fuel that's called spent fuel mistakenly because it's really just used. Most of it has not been spent yet. It can be reused and all of its energy taken out beneficially.

When Proposition 15 was defeated we had 15 percent of California's energy was provided by nuclear energy. We had just completed San Onofre and Diablo Canyon plants. Now we are down to 11 percent because we haven't added any more capacity to the state.

But if we were to use the growth factor of what we have now the growth factor is 3.8 percent. And using that growth factor we should have four more 1,000 megawatt reactors in operation by the year 2010. I don't think we're going to make that schedule. But let's proceed as rapidly as we can. Let's take out the roadblocks.

In actuality, looking ahead to the electricity needs in 2050, at that time we should have about 24,000 plus megawatt reactors operating in California if we are to remain economically viable and environmentally responsible. Thank you very much.

PRESIDING MEMBER PFANNENSTIEL: Thank you, sir. That's all of the blue cards I have. Is there anybody else here who hasn't spoken who would like to make some comments? No?

Last comments on the dais?

COMMISSIONER BYRON: We'll be back Thursday.

PRESIDING MEMBER PFANNENSTIEL: We will be back Thursday. Mr. McClary, did you have any final comments?

MR. McCLARY: Just one thing other than thanking the panelists and the public who were here today. To reiterate that the presentations of everybody who has been here today as well as biographical material will in fact be on the website as we get it in final form. That may not be by Thursday but certainly as we gather all the material we will have it available for you on the Commission's website.

PRESIDING MEMBER PFANNENSTIEL: Thank you. I would like to thank Barbara, Bob and Steve for organizing this. And clearly the panelists, both this afternoon and this morning's panelists, gave us a very rich record from which to draw some recommendations. And thank you to the public who was here.

I think that we are all interested in the subject. We know how important it is to us, probably more now than recent years. We have another full day on Thursday and we'll pick it up again. Thank you all, we'll be adjourned.

(Whereupon, at 4:16 p.m., the Committee workshop was adjourned, to resume Thursday, July 28, 2007 at 9:00 a.m.)

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CERTIFICATE OF REPORTER

I, JOHN COTA, an Electronic Reporter, do hereby certify that I am a disinterested person herein; that I recorded the foregoing California Energy Commission Committee Workshop; that it was thereafter transcribed into typewriting.

I further certify that I am not of counsel or attorney for any of the parties to said workshop, nor in any way interested in outcome of said workshop.

IN WITNESS WHEREOF, I have hereunto set my hand this 19th day of July, 2007.